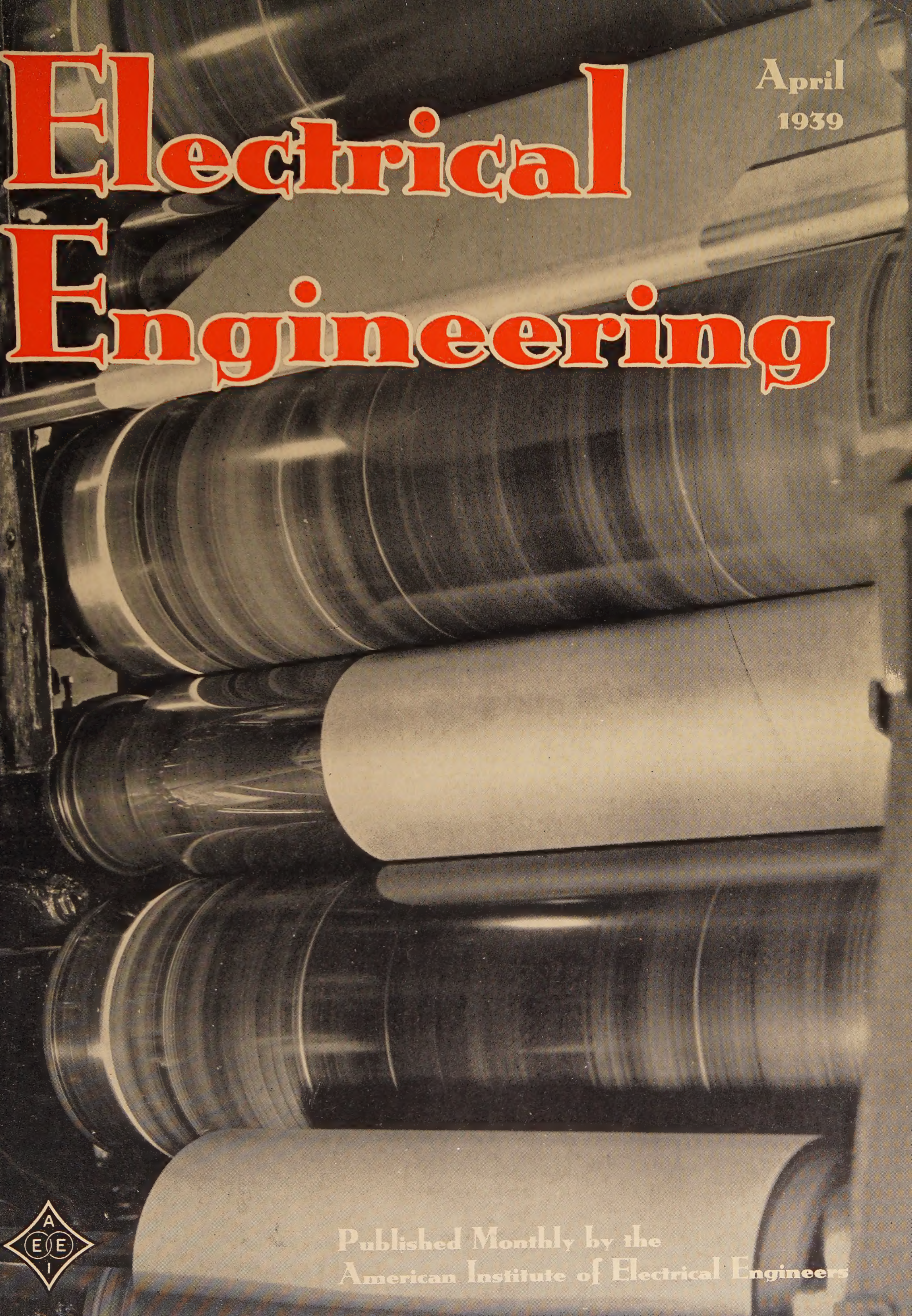
Electrical Engineering

April
1939



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Electrical Engineering

Registered U. S. Patent Office

for April 1939—

Transactions Section *(Follows EE page 190)*

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¶ Correspondence is invited on all controversial matters.

High Lights

Boulder Dam Line. Operating experience with the Boulder Dam-Los Angeles transmission line during its first $1^1/_2$ years of service is reviewed in a group of five papers presented at the 1938 AIEE Pacific Coast convention. Subjects discussed are the general operation of the line (*Transactions pages 131–7*); corona experience (*Transactions pages 137–40*); insulation and lightning protection (*Transactions pages 140–7*); carrier-current equipment (*Transactions pages 147–51*); and relay protection (*Transactions pages 151–6*).

Professions. Aware of possible differences of opinion, a noted educator traces the development of professions from that of primitive medicine men, and finds the common, distinguishing theme of a profession to be ministering to the people; engineering is found to have no single code of principles to guide its social relations, and to need a unity of expression for its professional preservation (*pages 156–60*).

Summer and Pacific Coast Convention. Special railroad facilities are offered to eastern members who plan to attend the AIEE combined 1939 summer and Pacific Coast convention to be held June 26–30 in San Francisco, Calif. A feature attraction will be the Golden Gate Exposition; in addition, the committee is making arrangements for extensive entertainment, sports, trips, and recreation (*pages 177–8*).

AIEE Members Invited. Invitations have been extended to AIEE members to participate in the following meetings: world automotive engineering congress (*page 178*); international conference on large high-voltage systems (*page 179*); Paris television symposium (*page 179*); a symposium on temperature and its measurement (*page 180*); and an international congress of mathematicians (*page 180*).

Generator Damper Windings. Recent investigations and tests have indicated that, in addition to reducing oscillations and improving system stability, damper windings are very effective for reducing high peak voltages in water-wheel generators during unbalanced short circuits. Damper windings may be added to machines already installed (*Transactions pages 166–71*).

Electricity at the Fairs. Special substations and distribution systems have been built to supply the electric energy needed to operate the New York and San Francisco 1939 World's Fair. Featuring the first large-scale application of fluorescent lighting, both expositions depict the striking progress achieved in electrical illumination during the past few years (*pages 149–51; 163*)

Electrical-Engineering Education. The term "engineering education" appeared for the first time in an Edison Medal citation when the 1938 medal was awarded to Past President Dugald C. Jackson. In his response at the presentation ceremonies, Doctor Jackson discussed some of the early history of electrical-engineering education (*pages 165–8*).

An Exciting 40 Years. In accepting the 1939 John Fritz Medal, Past President F. B. Jewett paid tribute to his many associates of the Bell telephone system, with which he has been associated for 40 years, and to the wisdom of those who 50 years or more ago had great visions and created the pattern of the Bell System (*pages 160–2*).

Reconditioning of Insulating Oil. In order to maintain its dielectric strength, insulating oil used in transformers and other electrical apparatus must be reconditioned periodically. Activated alumina has been found useful in removing acid from the oil, which is one of the products of deterioration (*Transactions pages 172–6*).

Graduate Training. In the March issue appeared an article challenging the necessity or usefulness of ordinary present-day graduate courses in engineering. Representative industrialists and educators see value in this type of training in some situations (*pages 168–74*).

Student Page. "The request of those members of the Institute who have been asking for a 'student page' or section in Electrical Engineering has been granted manyfold," says the current chairman of the AIEE committee on Student Branches in a "Letter to the Editor" (*pages 181–2*).

News 175

District Meeting. Power transmission and distribution and industrial power applications are the principal topics to be discussed during the technical sessions of the AIEE North Eastern District meeting to be held May 3–5, 1939 at Springfield, Mass. Plans for the meeting are nearing completion (*pages 175–6*).

Engineering Experience. Young engineers who are eager to qualify for legal recognition as "professional engineers" may find helpful the views on "qualifying experience" expressed by state registration examiners (*pages 152–3*).

Electric Strength of Air. Experiments show that the dielectric strength of air increases with pressure up to a "critical" point. The form of the electrodes was found to have an important bearing on the results (*Transactions pages 161–5*).

Gearmotors. Combination in one unit of an electric motor and speed reducer produces a compact machine which may be thought of as a slow-speed motor, available in a wide variety of standard ratings and motor types (*pages 154–5*).

An Invitation. AIEE members planning to attend the New York World's Fair are invited to visit Institute headquarters and take advantage of the facilities provided there for members (*page 162*).

Electrical Standards. With its technical committees covering practically every aspect of electrical engineering, the AIEE has an ideal setup for the development of electrical-standards material (*page 164*).

Coming Soon. Among special articles and technical papers undergoing preparation for early publication are: an article offering suggestions on seeking employment, by C. F. Dalziel (A'33); an article on the utilization of heat from the sun, by C. G. Abbott; a paper on dielectric breakdown in compressed gases by A. H. Howell (A'35); a paper on bus protection by the AIEE relay subcommittee and the Edison Electric Institute electrical-equipment committee; a paper describing a study of the performance of the 3,600-horsepower New Haven Railroad electric locomotives by Felix Konn (M'32) and F. H. Craton (M'38); a paper describing the Permatron, a magnetically controlled industrial tube, by W. P. Overbeck (A'39); a paper on continuous processing for automobile tire fabrics by G. E. Cassidy and W. A. Mosteller; a paper reporting the results of a study of the benefits of secondary versus primary capacitors by F. M. Starr (A'30); a paper describing the crossbar dial telephone-switching system by F. J. Scudder (M'25) and J. N. Reynolds; and a paper on copper-oxide modulators in carrier telephone systems by R. S. Caruthers.

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Electricity for Treasure Island

Featuring widespread use of fluorescent lighting, the Golden Gate Exposition is a symbol of the marked progress in electrical illumination achieved in recent years

By WILLIAM P. BEAR
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MEMBER AIEE

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TREASURE ISLAND is 400 acres of sand pumped out of San Francisco Bay; but those attending the combined summer and Pacific Coast Convention of the AIEE to be held in San Francisco, June 26–30, 1939, and other visitors to the Golden Gate International Exposition, will remember it as a scene of rare, colored beauty. Electricity will have been responsible for that. Electricity is what makes the San Francisco Fair different from those that have gone before. Treasure Island is a symbol of the progress that has been made in illumination in just a few short years.

Electricity reaches Treasure Island by way of three 500,000-circular-mil three-conductor 12-kv submarine cables from Oakland and San Francisco. The Pacific Gas and Electric Company meters the energy on a demand-plus-energy basis to the exposition company. Point of delivery is a 16,000-kva substation located in a corner of one of the permanent airplane-hangar buildings on the island. This is augmented by a second substation of 4,000-kva capacity, which serves the Gayway, or amusement zone. Present demand at the fair is over 12,000 kw, but this is expected to reach at least 16,000 kw as the exposition gets into full stride.

First transformation is from 12,000 to 4,000 volts through four 4,000-kva three-phase units, each of which is provided with tap-changing-under-load equipment. From the main substation, 15 feeders, each a four-kilovolt four-wire star-connected circuit with grounded-neutral grid system, and each capable of carrying 1,500 kva, provide primary distribution to 43 transformer vaults located throughout the grounds. Fifteen of these vaults contain a second bank of transformers used for decorative lighting only and fed directly from the substation over special four-kilovolt feeders, as noted later. Four vaults also contain banks for 480-volt service for fountain pumps. Four more feeders originate out of the Gayway substation. Feeders are laid in trenches, covered with redwood plank, and each consists of three number 4/0 40-per cent rubber, tape-and-braid-insulated conductors. Neutrals are bare. Lengths of duct are employed where feeders pass under roadways.

Principal reason for the selection of radial distribution was that switching could be simplified. To minimize the effect of a possible outage on one feeder, adjacent transformer vaults are connected to different feeders. Thus the effect of an outage would be scattered, and one whole section would not "black out."

Transformer banks are three single-phase transformers, 2,400/120 volts, connected wye-wye with common neutral. This system was adopted on account of the predominance of lighting load. Taps are taken off the feeders to supply the transformers through oil cutouts. The secondary distribution for decorative and general lighting purposes is four-wire 208-120 volts.

Most of the decorative lighting is served over four four-kilovolt feeders, exclusively for this purpose, so that con-

WILLIAM P. BEAR is illuminating engineer for the Pacific Gas and Electric Company, San Francisco, Calif. WILLIAM R. VAN BOKKELEN is chief of the division of electricity, 1939 Golden Gate International Exposition. WAYNE SNOWDEN is engineering editor of *Electrical West* and Pacific Coast editor of *Electrical World*, San Francisco.

trol is centered in the main substation. The street lighting is a 6.6-ampere series system, employing ten circuits including one sodium-vapor-lamp circuit. Four circuits emanate from the substation and the others cascade off of them. The 208-120-volt decorative-lighting circuits are extended to fused disconnecting panels near the loads, from which points they are connected to 12,000-watt circuits (35-ampere four-wire) by open wiring on racks or railings.

Most of Treasure Island's main exhibit palaces are long and narrow. Distribution of low-voltage all-purpose energy throughout palaces of this shape lent itself to a scheme wherein three physically parallel "busses" were run the length of the palace, and individual services tapped from these.

Throughout, the wiring has been kept quite simple, a procedure that is consistent with the temporary nature of the installation. Use of first-class materials, however, was considered to represent best economy for gaining high reliability through this simple scheme.

What makes Treasure Island electrically spectacular, and significant, is the first widespread use of fluorescent tube lamps. More than 2,300 of these lamps, each of 15-watt rating, are used for floodlighting. Colors employed are blue, pink, green, and gold, and for the most part the units are mounted in trough reflectors and concealed behind shrubbery and setbacks, or in niches and windows, and used for the exterior decorative lighting of the inner courts.

The startling color effects that are typical of the San Francisco fair are achieved by the ingenious use of these fluorescent units in conjunction with ultraviolet radiation and fluorescent paint, with high-intensity mercury lamps, and with standard floodlights employing color filters.

Dimensions of the lighting installation can be judged from the fact that for spectacular outside lighting alone 8,000 Mazda floodlighting units are employed in addition to the 2,300 fluorescent tubes. These figures do not include the ultraviolet or mercury-vapor units. To this total load should be added 225 kw which is required for lighting streets, roads, and lanes. Street lighting consists of the 6.6-ampere series Mazda installation on the island proper, with a sodium-vapor installation on the roadway constituting the approach by land. (Treasure Island may also be reached by ferry—the only way except for those traveling by automobile.)

The character of Treasure Island lighting was dictated by the architecture, which follows a Mayan theme. While this is far more ornate than the style that might be termed "modern," it embraces several characteristics of modern architecture—such as the use of large surfaces and an essential simplicity of fundamental forms—yet presents sufficient detail to forestall any impression of its being stark. It is angular rather than curvilinear and is suggestive of Oriental designs. Thus the architecture presented illuminating engineers with large surfaces to be illuminated as well as with ornamental areas which afforded endless opportunities for contrasts in intensity and color.

Palaces facing the Court of Reflections are illuminated by pink fluorescent lamps. Cambodian lighting standards flank the walks

An example is the Court of the Moon, perhaps the most spectacular lighting achievement of the entire fair. The main impression is of deep blue-violet and brilliant blue, hard to imagine and harder to compare, because nothing like it has been seen before. In the grills and tower caps this is contrasted with rose, while at the center of the court the whole is brought into color balance by means of goldlighted jets of water which arch into the central pool.

This effect was achieved somewhat as follows: To obtain sufficient blue intensity to cover the large wall areas (450 feet long by 80 feet high) both fluorescent and Mazda units were employed. The Mazda units consist of floodlights with 500- and 1,000-watt incandescent lamps and blue color screens. These are installed at ground level, concealed behind a low retaining wall and shrubs.

The fluorescent units, also blue, are similarly placed. As elsewhere at the fair, the fluorescent tubes are mounted in individual troughs, designed for low cost and constructed of aluminum covered with glass. Each trough is supported on its own base which consists merely of a piece of board. This arrangement permitted shifting the fluorescent units in relation to the Mazda units until the desired effect was obtained.

According to estimates, to have floodlighted the Court of the Moon with Mazda lamps alone would have required six times as much energy as is consumed by the combination. Fluorescent units are used to illuminate the lower portions of the walls and Mazda floodlights to reach the upper portions. Where the illumination is most uniform, that is, along the unrelieved surfaces 80 feet high, the ratio between types of units employed is about one fluorescent to two Mazda. The rose color is achieved very simply by the use of pink fluorescent tubes.

The fountain jets are illuminated from below by underwater floodlights using amber color screens. The underwater units here, as throughout the exposition, are mounted on small movable concrete blocks and are fed through rubber-covered cord. This arrangement provided flexibility

for proper placement of the units initially and is considered to afford a permanence consistent with the length of service. The 400-watt mercury-vapor units which illuminate the trees are set in the ground.

Situated in the midst of San Francisco Bay, Treasure Island is a spectacle to those who view it from a distance, as well as to those who are on the island itself. This was no chance occurrence. The lighting was planned to produce beauty from both perspectives, and this was no small problem for illuminating engineers.

Central architectural feature from both far and near is the 410-foot Tower of the Sun. The plaster surface is a light sand color. To cause the tower to stand out when viewed from a distance, and to achieve a gradation of hues ranging from rich amber at the bottom to light amber at the top, eight lighting banks were located on the roofs of surrounding palaces, each bank serving to illuminate one longitudinal segment of the tower. Each bank consists of six 1,500-watt clear Mazda searchlights and three each of amber and clear 1,000-watt Mazda floodlights.

Near the bottom and again near the top, the tower is arched. Interior surfaces exposed by these arches are easily subject to decorative treatment. This could be achieved only with illumination of considerable intensity since the exterior surface, with which the arches had to contrast, was already subject to illumination at a comparatively high intensity. Hues employed are red and deep amber. To obtain these, the following units were employed: 48 1,000-watt amber, and 136 500-watt red and amber. All Mazda floodlights are concealed in niches of the tower. At the top of the tower is a great gold bird, a phoenix 22 feet high, lighted from below by means of eight 500-watt red spotlights.

In contrast to the high intensities required for decorative effects upon the tower are the striking contrasts achieved elsewhere by means of a single fluorescent tube. For example, in the Court of Reflections (which derives its name from the fact it centers around still-water pools) the palace walls are illuminated in salmon pink by means of pink fluorescent lights. At intervals along the walls are some octagonal niches about 10 feet in diameter. A single 15-watt blue fluorescent tube serves to illuminate each niche.

Another thrilling combination of effects is achieved in the Court of Pacifica. Pacifica, goddess of the fair, is an 80-foot statue, standing at one end of her court, just in front of a steel, star-studded screen. This screen is built over a light box, and thus appears in silhouette. The light box is evenly illuminated from within by means of concealed floodlights. These are thyratron controlled so that the entire lighted surface is caused to pass through a spectrum of colors, at any given instant all portions of the surface being of the same hue. Pacifica faces a series of fountains in which the water itself appears to be colored, mainly green. Actually, the water is flowing over translucent plastic domes which glow by reason of colored lighting units concealed within, also thyratron controlled.

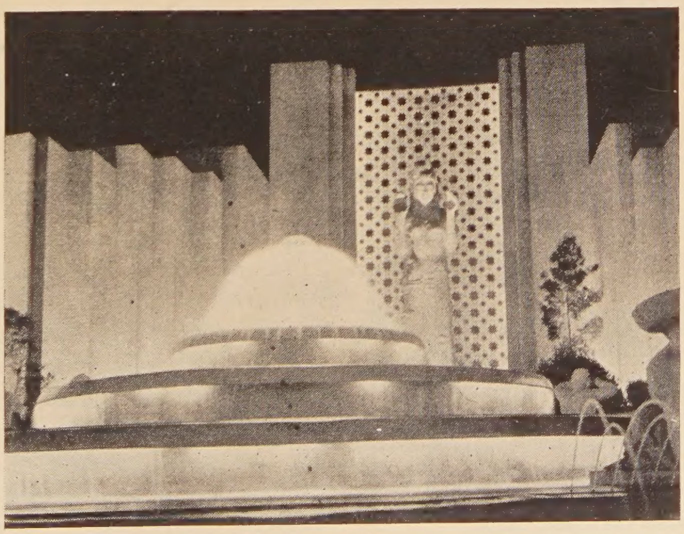
A combination of Mazda and fluorescent lighting is used to illuminate in blue the 80-foot-high palace walls in the Court of the Moon

Standards for lighting streets, walks, and grounds are Cambodian in style. There are many variations, but the following indicates how one type is constructed and is, to a degree, typical of all: Tubular, tapered steel poles are employed. Some are as high as 86 feet. In one type, 40- or 60-watt lamps are supported on wood battens which are strapped to the pole. Around the poles, functioning like transluscent "lamp shades," are Glyptol-treated canvas tubes (cylindrical housings) supported on metal rings and fastened up the back with a "zipper."

Lighting is the big show at the San Francisco exposition and to electrical engineers is both a recreation and a study. It must be seen to be appreciated. Lighting methods can be described, but no words can describe the effect, which of course is the only aim.

The electrical plans were engineered by the exposition's division of electricity, of which W. R. Van Bokkelen is chief. The substations, distribution system, transformer vaults, and outdoor decorative lighting were installed by the electrical staff of the exposition under supervision of G. E. Garthorne, assistant engineer. Interior wiring was installed by electrical contractors. The General Electric Company acted as consultants and designers of the decorative and spectacular lighting. A. F. Dickerson, manager of the illuminating laboratory and lighting sales at Schenectady, N. Y., supervised this work.

Changing colors silhouette the screen behind Pacifica. The water of the fountain flows over a translucent dome



What Is Engineering Experience?

By CHARLES F. SCOTT
HONORARY MEMBER AIEE

Young engineers entering the "school of experience" may find pertinent suggestions in the views of state registration examiners as presented to the National Council of State Boards of Engineering Examiners in a recent report on "Qualifying Experience" which forms the basis of this article.

SAID a young applicant to the secretary of a state registration board: "I don't understand why your board refuses to grant me a license as a professional engineer. Your requirements are a diploma and four years of experience. I have a diploma and five years' experience, but you turn me down. Why is it?" The reply of the secretary opened the eyes of the applicant. "You have been doing routine work which has not added to your professional development," he said, "your experience is not 'satisfactory to the board.'"

Arbitrary as this reply may appear, the secretary was fully justified in making it as the phrase "satisfactory to the board" is part of the wording of the law. If, therefore, so definite—or indefinite—a phrase is to be found in the law, it is fitting that the registration boards should undertake an interpretation.

What kind of experience, then, is "satisfactory to the board?"

The National Council of State Boards of Engineering Examiners has been studying this question, and received at its meeting in October 1938, a report from its committee on qualifying experience, of which the writer was chairman. The report, "Presenting a Situation: Not Attempting a Definition," was a composite of contributions by members of registration boards; it had been submitted for criticism to members of the boards in some 40 states.

The young man looking forward to an engineering career and to professional recognition in which his experience record will be scrutinized by his engineering-society admissions committee and his registration board, will find much that may be helpful in the significant portions of the report which are here presented.

The Experience Period

The experience period following graduation is a vital factor in the career of the individual engineer and in registration procedures. *To the recent graduate* this experience period is the opportunity for practice in using the knowledge and training of the past in laying the foundation for a future career.

To the engineering registration board the reaction of the applicant to the test of experience indicates whether the man has the qualities the professional engineer should have. It indicates his intellectual habits and attitudes, his methods of thinking and doing, his facility in combining theory and practice, his ability to handle new problems, to visualize, and to plan, his capability to develop as shown by the use he has made of opportunities for self-development. From the record of what he has done and how he has done it the board has the best basis for projecting his performance curve into the future, as indication of his competency to practice professional engineering.

The Model Law

State engineering-registration laws usually are based upon a model law prepared by and recommended by a number of the national engineering societies. According to the model law, "the practice of professional engineering . . . includes any professional service . . . wherein the public welfare or the safeguarding of life, health, or property is concerned or involved, when such professional services require the application of engineering principles and data."

It defines a "professional engineer" as " . . . a person who is qualified by reason of his knowledge of mathematics, the physical sciences, and the principles of engineering, acquired by professional education and practical experience, to engage in the practice of professional engineering." Hence the qualification involves the combination of knowledge and experience.

Normally, according to the model law, the requirements for registration are an acceptable diploma and a "specific record of an additional four years or more of experience in engineering work of a character satisfactory to the board, and indicating that the applicant is competent to practice professional engineering." (If there be no diploma a longer experience is required.)

"Four years or more" implies that the length of the period is to be adequate for acquiring the experience. The minimum of four years should be deemed sufficient only in exceptional cases where the experience has been unusually broad in scope, progressively better in character, and notably high in both average and final level.

"Character of experience" implies that some kinds of "experience" are not satisfactory; for example, routine performance which does not invoke the application of technical knowledge and which does not contribute to development of qualities which indicate competency to practice professional engineering. Character means *quality*, not mere *quantity* of experience measured in time (though a minimum is fixed) or jobs, and the quality must indicate competency.

CHARLES F. SCOTT is professor of electrical engineering, emeritus, Yale University, New Haven, Conn., and is currently president of the National Council of State Boards of Engineering Examiners. Doctor Scott was chairman of the committee that prepared the report on which this article is based.

Satisfactory Experience

Broadly, character of experience that is satisfactory is that which indicates competency to practice professional engineering, and the "ability to do." Specifically, the following items are pertinent.

The school of experience should be a laboratory for the application of principles to the solving of problems. Knowledge and experience should become integrated so that they interact and produce something far beyond the arithmetical sum of textbook information and the doing of routine tasks.

On the same job one may exercise judgment in directing the work, while another may simply follow plans and specifications to the letter. Again, in design one may use judgment in choice of standards while another may make slavish use of them.

Qualifying experience is not derived from work that does not require or involve the application of engineering principles and theories, although the work itself may require skill and may be necessary in professional activity; for example, ordinary surveying, drafting, mechanical calculations, or routine cost accounting. Acceptable experience must involve the intelligent practical application of the laws of physical science.

Experience should be sufficient in amount so that repetition produces (1) thorough understanding of the principles involved and (2) the development of judgment as to the method of analysis and solution.

Two phases of experience are (1) the actual activities performed and (2) the attitude of the individual and his progressive development in performing them. What he does is of less consequence than how he does it.

There is bound to be a dividing line between those who are indifferent to development and those who are bound to achieve against all obstacles, if professional engineering is to develop on the basis of higher standards.

A progressive advancement in the application of engineering data and principles should indicate that the applicant is capable of taking charge of some branch of engineering work. He should recognize his limitations as well as his ability, and should decline to accept a commitment that he knows he is not qualified to fulfill.

A board should secure details of an applicant's duties and responsibilities by asking such questions as these: What did he do? What engineering data or principles did he apply? What engineering judgment and discretion did he exercise? What was the scope and importance of the project? What is the ability to devise and to plan? What is the evidence of progressive responsibility? What initiative and originality and courage, and what personal force for overcoming difficulties have been shown? What aid to progress has been secured through reading and study, through membership in an engineering society, through correspondence-school or night-school courses?

Obviously, a board cannot rely on titles—they may be very deceptive. Jobs and positions and things done are significant only as to qualities essential to the professional engineer which result.

Practical experience is thus defined in handbook 36 of the New York State board of licensing for professional engineers:

> Practical experience in professional engineering work to be considered to be of a grade and character satisfactory to the Board of Examiners shall be such as to require the intensive application of engineering principles in the practical solution of engineering problems. This work shall predicate a knowledge of engineering mathematics, physical and applied sciences, properties of materials, and the fundamental principles of engineering design. It shall be broad in scope and of such nature as to develop and mature the applicant's engineering knowledge and judgment.

Supplemental Qualities

In general, registrants who possess administrative ability are eligible for the higher ranks in their profession; they have desirable qualities for making them "competent to practice professional engineering." Administrative ability is, therefore, a desirable though not an essential quality; it may be given consideration in estimating experience as qualifying for "professional engineering" practice.

Professional engineering (as defined in the model law) includes " . . . evaluation, planning . . . in connection with any public or private utilities . . . works or projects, wherein the public welfare, or the safeguarding of life, health, or property is concerned." It seems reasonable, then, to expect more than mere physical competency.

Economic justification and social utility are within the larger engineering perspective. Ability to take this larger view and to co-ordinate many engineering elements in a single project and to adjust it to the environment outside the technical elements, by looking beyond engineering efficiency to social utility and public welfare, is a quality of our outstanding engineers—a quality to be developed through the years. But, if added to normal knowledge and experience a young man gives promise of a larger outlook on engineering and life, the board enjoys a double assurance that it is making a wise selection.

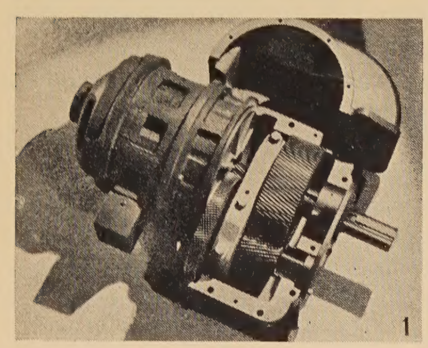
Registration—A New Development in Engineering

Engineering registration in theory and practice is a pioneering effort. Of the 40 states having registration, 90 per cent have not had it more than 20 years and 30 per cent of them have had it less than 4 years. In some states the procedures in licensing are well developed; in others they are just beginning. The National Council seeks to interchange information and unify objectives.

Just as engineering schools and societies and engineering theory and practice progress, so must the goals and the procedures in engineering registration. The evaluation of experience cannot be effected through dogmatic definition; discretion must be exercised in each specific case. The applicant should realize that the true function of technical knowledge and qualifying experience is to produce competency to practice professional engineering. This may seem indefinite and intangible. It is. It cannot be measured by objective yardsticks; there is a human quality involved in interpreting what is "satisfactory to the board."

Recent Developments in Gearmotors

ELECTRIC motors and other types of prime movers rotate at much higher speeds than do the majority of driven machines and therefore some means of speed reduction is necessary. One of the most important and most efficient of methods is gearing, which satisfies the fundamental requirements of compactness and high mechanical efficiency. With helical gears mounted on antifriction bearings and running in oil, efficiencies of 98 per cent for single-reduction gear drives and 96 per cent for double-reduction drives may be attained. Initial cost is always important in the purchase of power-transmission equipment, and surveys indicate that in the majority of applications the gear transmissions can be purchased for a lower initial cost than can other types of drives. This is also true for slow-speed motors which would form an alternate for the high-speed motor and some form of speed reduction.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Although gears themselves have been in use for many years as a means of speed reduction and power transmission, it was not recognized that there would be a demand for standardized gear drives. Today speed-reducer units and gearmotors for both horizontal and vertical operation are available for a wide range of horsepowers and output speeds. In gearmotors a large variety of motor designs may be had and the user generally can find a standard piece of apparatus for the majority of industrial applications.

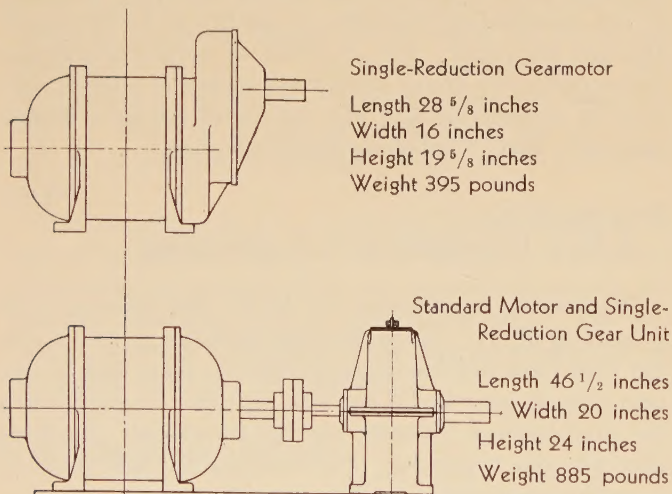
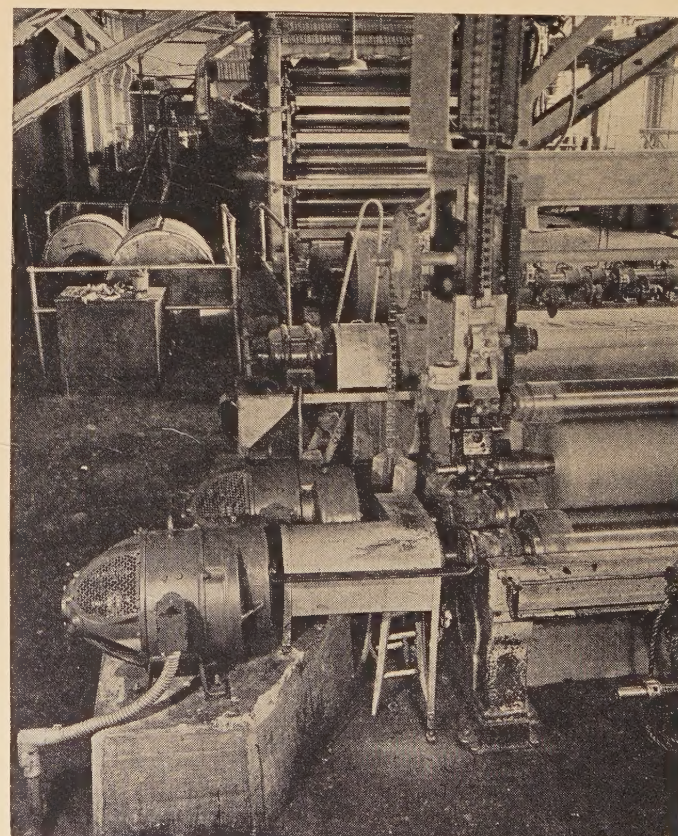


Figure 2

Abstract of a paper delivered before the AIEE Springfield Section on September 12, 1938, by R. S. Marthens, manager of the gearing division of Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

Gearmotors should be considered as slow-speed motors wherein the transmission parts have been so designed that the full torque of the motor during both starting and overload periods can be transmitted without injury to the gearing parts. Various types are available, such as open-type squirrel-cage motors, totally enclosed fan-cooled, and double-reduction gearmotors with speed reductions as high as 40 to 1, and gearmotors with special slow-speed-shaft extensions and with high-speed motor-shaft extensions for the mounting of brake parts.

Much thought has been given on the part of gearmotor designers to the type of construction to be used for the gear case and necessary adapter to enable the manufacturer to use standard motor frames which are brought through the shop in quantities. For gear ratios higher than approximately nine to one, a type of construction is most generally used wherein the supporting feet are a part of the gear housing and a round-frame motor is used, supported from this same housing. Figure 1 illustrates this type of construction. The split-case construction also provides ease of assembly and dismantling and the gear ratio may be changed quickly either in the factory or in the field. In the design of the gear case, special attention is given to the adequacy of the bolts, for the torque at the output shaft of the gearmotor is the torque developed by the motor parts multiplied by the gear ratio. Adequate support is also necessary for overhung loads where the connection to the driven apparatus is through a belt drive,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chain drive, or open gearing. Close co-operation is required between the gear designers and the motor designers to provide the proper mechanical parts for transmitting the developed torque.

In many respects the type of construction for industrial speed-reducers built as separate gear drives and gearmotors is identical. In both, lubrication is a relatively simple

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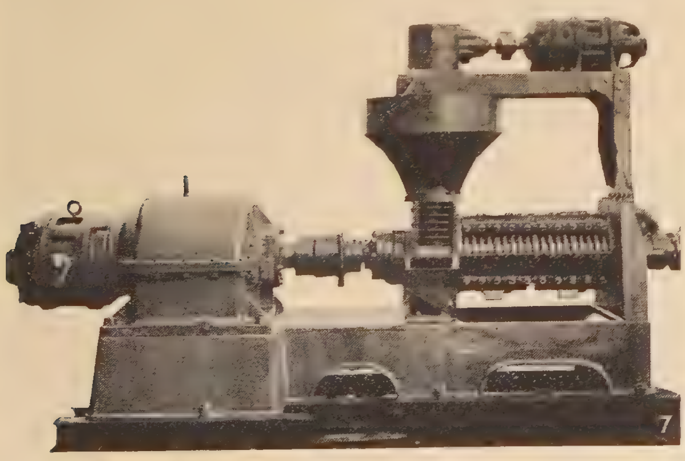
problem, because the same oil may be used for both the gears and the bearings. The difference in space and weight for gearmotors and coupled-type speed reducers is illustrated in figure 2. This example is a 15-horsepower 1,750-rpm set of motor parts combined with speed-reducer parts which provide an output speed of 350 rpm. The gearmotor shows a saving in length of 38 per cent, in width 20 per cent, in height 18 per cent, and in weight 55 per cent. Also, a saving is obtained in the price of the gearmotor.

A general survey of industrial applications indicates that approximately 80 per cent of all motors one horsepower and above are connected to the driven machines through some form of speed reduction. An application of gearmotors where a compact drive is necessary is illus-



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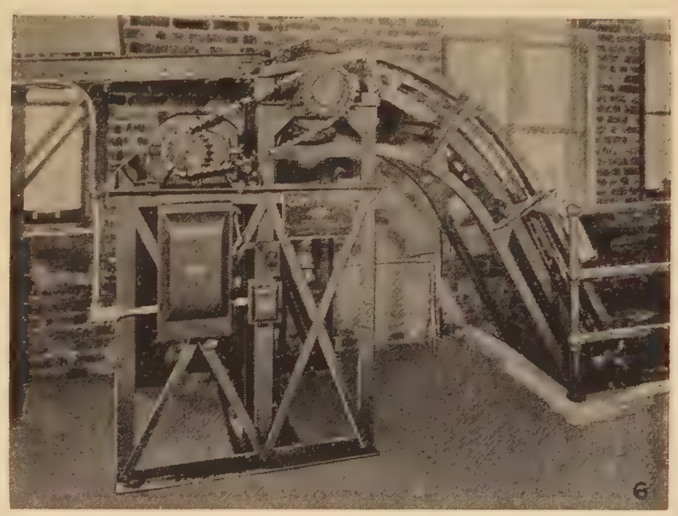
trated by figure 3. Here two gearmotors are used to drive a winder in a paper mill. The center distance on the driving rolls is such that the usual type of drive could not be used. These gearmotors employ wound-rotor induction-motor parts combined with a single reduction in the gearing parts of approximately five to one. When a single reduction of external helical gears is used, the output shaft is offset from the motor shaft. The gear case has been so designed that it can be rotated on the motor frame and the output shaft may be in any one of four positions. By choosing two of these positions and staggering the motor frames, this compact drive is obtained.

A machine tool application is illustrated by figure 4, which shows a 15-horsepower single-reduction gearmotor applied to a metal-cutting saw. Four output speeds are obtained by the use of four-speed induction-motor parts.

A special application of gearmotors is shown in figure 5. A 75-horsepower 22-rpm gearmotor is used for this dredge cutter drive and the gearmotor is coupled directly to the cutter shaft. Splash-proof motor parts are used and the oiling system for the gears has been arranged so that the



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cutter shaft can operate from the horizontal to a maximum of 50 degrees below the horizontal. The bearings on the output shaft of the gearmotor absorb the thrust from the cutter.

Many gearmotors have been used in conveyor applications where extremely low speeds are required. Such application is illustrated by figure 6; here the gearmotor is mounted directly beneath one portion of the conveyor and only sufficient space is required alongside the conveyor to provide for the chain drive connection to the head shaft.

When very low output speeds are required, together with minimum space, triple-reduction gearmotors frequently are employed. The gearmotor shown in figure 7 is a 50-horsepower unit using general-purpose induction-motor parts and having an output speed of 13 rpm. Vegetable oil is obtained from shale in this expeller-type press, and the gearmotor drive has proved quite satisfactory over an extended operating period. Many geared drives have been in successful operation 24 hours a day, six to seven days a week, for upward of ten years.

The Qualities of a Profession

as outlined in a recent address delivered before American Engineering Council

By VANNEVAR BUSH
FELLOW AIEE

IN 1937, at Milwaukee, I attempted an analysis of the organization of the engineering profession.* Here I wish to develop that theme somewhat and I intend to trace briefly the relationship of engineering to the other professions, the professional traditions which engineers inherit, and the outlook for the engineering profession in view of its unique relationship to society. I plan to review the history of professions very sketchily; but through this history runs a thread to which I wish especially to direct your attention.

We can start far back, but not tarry long in our review. In every primitive tribe there was some sort of medicine man. He was a man apart, the advisor of the clan rather than its titular leader. He spoke, in his field, with authority, and this rested upon a special knowledge which he was supposed to possess. The medicine man was the progenitor of the professional man of today.

His closest modern counterpart is the scientist. The scientist and the medicine man have much in common. Tribal regalias and feathers have undergone metamorphosis and reappear in cabalistic titles and letters surrounding names. The queer jargon of the cult has changed in nature but preserved its hypnotic effect. Solemn pronouncements about the unknowable still catch the ear of the multitude. The claim to a favored position in society is still based on the occasional ability to unscrew the inscrutable. In fact, one difficulty that faces the scientist is that he may be mistaken for a medicine man; able at will to produce rabbits from hats, instead of the careful, hard-working, human individual he really is.

The descent of the engineer from the medicine man has been highly involved; and it will clarify some obscure relationships if we trace part of it; for there is a central thread which runs through the tale.

The medicine man, and the member of the pagan priesthood which succeeded him, was characterized by numerous attributes. He had a strict code of conduct. He trained neophytes, subjected them to a long period of apprenticeship, initiated them into the mysteries, and inculcated in them pride in the cult, and rigid discipline in its formulas. He severely restricted his numbers, by intellectual hurdles to be surmounted. He spoke a special language. He sat as advisor in councils of the mighty. But, more essential than all of these, he ministered to the people.

This was the first professional group, and all others have derived from it. Not every attribute has been maintained as new professions have emerged; but to a surprising extent their counterparts can still be found. In every one of the professional groups, however, will be found the initial central theme intact—they minister to the people. Otherwise they no longer endure as professional groups.

Ministry needs definition for our purposes. The alteration of word meanings with new usages is such that it is only too easy to be misunderstood. Ministry is not service, and we have so completely altered the essential significance of the latter word that it may have utterly different connotations to different hearers. Ministry carries with it the ideas of dignity and authority; it connotes no weakness, and offers no apology. The word has been carried into diplomatic usage; and in the derived form of administer into law and business. There is no fog of subservience surrounding the concept. The physician who ministers to his client takes charge by right of superior specialized knowledge of a highly personal aspect of the affairs of the individual. The attorney assumes professional responsibility for guiding the legal acts of his client, and speaks with the whole authority of the statutes as a background. It is in this higher sense that we trace the thread of ministry to the people.

This is the fuel which has kept alight through many ages the professional spirit. Every time that the fuel has become exhausted, the light has gone out. It has not mattered how much was retained of trappings and mysticism, nor what the profundity of utterances, there has been no true profession that has not with dignity and authority advised and counselled the people, that has not guarded the commonweal. For a true profession exists only as the people allow it to maintain its prerogatives by reason of confidence in its integrity and belief in its general beneficence.

The monastic orders, under divers religions, springing up as outgrowths of the simpler systems of priestcraft, have exemplified the theme in two ways. Some have preserved, adorned, and extended the knowledge of their time and place. These have their modern counterparts in the scientific and learned groups, the custodians of our culture, and the source from which flows new knowledge for the use of man. Other orders carried to great heights the direct ministry to those in misfortune or distress; often at great self-sacrifice, as did the early Jesuits among the Indians of our west. Both forms have remained high in the esteem of the people and have endured. Occasional groups have lost the thread, and have, for example, be-

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An address delivered at the "All Engineers' Dinner" of American Engineering Council, Washington, D. C., January 13, 1939.

VANNEVAR BUSH is president of the Carnegie Institution of Washington, D. C. He formerly was vice-president and dean of engineering at Massachusetts Institute of Technology, Cambridge; a biographical sketch of Doctor Bush appeared in the July 1938 issue, page 319. He is chairman of the AIEE Lamme Medal committee, and representative on the council of the American Association for the Advancement of Science and on the National Research Council's Division of Engineering and Industrial Research, of which he is chairman.

*"The Engineer and His Relation to Government," delivered at the AIEE summer convention, Milwaukee, Wis., June 22, 1937, and published in the August 1937 issue of ELECTRICAL ENGINEERING, pages 928–36.

come militant orders devoted to self-aggrandizement; and these have disappeared.

The Teaching Profession

Out of the early priesthood came also the teaching orders, whose ministry took the form of instruction of the young, and this aspect of professional activity is represented today by the great profession of teachers everywhere. This group has little indeed of the trappings of the medicine man, it has no single closely knit aggressive society representing it; its language is becoming complicated but is still fairly intelligible to the layman. Where it has maintained its ideals it is honored and respected. Great teachers do not find riches heaped upon them, they do not become affluent. Great teachers have no interest in riches. In the great teacher the parental instinct, which is so often at the basis of senseless extremes of individual striving for wealth, becomes sublimated into a broad love of youth which calls for neither wealth nor power for its enjoyment and satisfaction.

The Medical Profession

A very early offshoot was the profession of medicine, for ministry to the ill was a primitive need. It has had a long and distinguished history. Utilizing the fruits of science it is today in full tide of accomplishment for the benefit of mankind. It has had vast power and influence. Yet, today, in the United States, it is at a turn of the road, and its most thoughtful members are giving earnest consideration to its future. There is serious danger that its light may fail, and its heritage of idealism may be lost.

The profession of medicine, by reason of its very nature, has preserved many of the attributes of the ancient forms. It selects its neophytes by rigorous intellectual elimination, trains them over many years, and seeks to endow them with the philosophy of their profession. It severely restricts its own numbers, perhaps too severely in view of the task before it. It preserves itself apart, by special language, and has a unique code of conduct. It has sat in the councils of government and advised. By the will of the people it has been given special privileges and prerogatives for use in pursuit of its objectives. It is highly organized.

Through long ages it has held well to its ideal of simple ministry to the people, and has disciplined under its codes those who would use its special privileges for other ends. It has guarded the people against their own folly, and has been properly militant in maintenance of its sphere of the public weal. Its individual members are in general respected in their own communities to an extraordinary degree.

Yet, in these days when all institutions are undergoing scrutiny, when our population in fear and distress is prone to be critical, there is evidence about us that the profession, as a profession, does not command that full support of the people of the country without which it cannot continue on the path. Yet as one looks about in the medical profession signs are seen of a resurgence of idealism, a re-emphasis on the simple mission of healing, and a recognition of the central theme of ministry to the people. This I am convinced is the true motive of the great majority of the members of this grand profession. Yet there is much suspicion in the public mind that aggrandizement, utilization of power for the professional advancement of the membership, the guild spirit in its cruder form, are rampant. I second the thought of many eminent members of the profession itself that unless this suspicion is allayed by a revival of simple ideals, the profession will suffer, and the people will suffer enormously with it. It is well that engineers should be deeply interested in the outcome, for medicine is a very ancient profession from which we have much to learn.

The Legal Profession

To treat the origins of the profession of law, its codes and countercurrents, would require an article in itself. Here is a field in which the preservation of the true philosophy of a profession is intricate indeed. Endowed with special privilege under the law, it largely regulates its own conduct. Never quite successful in the recruiting, training, and indoctrination of its neophytes, its maintenance of adherence to a high code of conduct is rendered more difficult. Counseling with government, and by the nature of its mission, participating directly therein, it has great power for good or evil. It certainly strives, as an organized profession, for the public welfare; but its zeal in this regard is not always such as to cause it to disregard the special welfare of its own group; and the two, withal, are sometimes hard to disentangle. It ministers to those in legal distress with great effectiveness; but the distressed often appear in pairs. It is hardly judged as a whole by the public. Certain it is, however, that those of its membership, on the bench or at the bar, who have risen to the highest positions in their devotion to professional ideals, are respected and honored by the public. Certain it is also, that, should this respect falter, we as a democracy would soon be in a sorry state.

The Engineering Profession

But our principal concern here is the engineering profession, and we inquire, what is the engineering profession; is it a profession at all; and if it is, will it develop into the full stature to which the importance of its works entitles it to aspire?

It is relatively young. The military engineer appeared in the first steps of the mechanization of warfare, when forts began to take shape. His counterpart in peaceful affairs was called a civil engineer. With the industrial revolution, and especially with the spread of mechanization from the factory into every walk of life, engineering became exceedingly diversified. Applying science in an economic manner to the needs of mankind is its broad field. Its disciplines are spread over all the sciences as they become thus applied, and embrace also portions of economics, law, and business practice which are integral parts of the process of application. It is somewhat loosely

organized as professions go. To a minor extent, only, it limits its numbers; but the very strictness of its essential disciplines provides some selection of its neophytes. Until recently it has done very little in an organized fashion to inculcate in its younger members the philosophy of the profession, leaving this largely to those of its individuals who are also members of the teaching profession. That branch which represents the consultant, and others to a degree, have drawn codes; but there is no body of codified principles which is accepted and applied by the profession as a whole. It has no highly distinct language or jargon, for it must continuously work with laymen.

These are, however, incidentals. The important point is this: Does it have a central theme of ministering to the people? Most certainly it serves the public in myriad ways, but are its individual members activated primarily by the professional spirit of dignified and authoritative counsel and guidance?

The Business Profession

In order properly to inquire into this weighty question, we need to digress a moment to consider another large group of the population, the modern men of business who have derived from the ancient traders and merchants. The merchant class has not usually been a professional grouping in the true sense; and engineering, which has derived its philosophy from this source as well as from science, naturally partakes of the heritage of both groups. Business has served the public, of course, but its main theme has been the profit motive, a salutary objective when restricted by law to the use of ethical procedures in its pursuit, but not a professional objective.

One of the most encouraging signs of the times is the gradual emergence in our day of the truly professional man of business. Scattered, not organized, with no sign of professional trappings, they are nonetheless possessed of a high mission, which needs only formulation and recognition in order that they may constitute a new and strong profession. This is occurring for one reason because of a gradual change in corporate form. The owner-manager was activated by the profit motive, and no amount of paternalism could wholly alter his position in the social scheme. Even with corporations, the ownership of which is widely scattered, the manager is ordinarily controlled by and primarily responsible to a few powerful owners, so that he in essence still represents the interest of the owners in his relations with the three bodies with which he deals; the government, the employees, and the consuming public. It is his difficult task to reap for the owners' benefit the fruits of his industrial operation; while maintaining at least tolerance on the part of the other bodies. But there are some corporations in which ownership is so diffused that the management becomes in effect a self-perpetuating entity, partaking therefore of the nature of a trusteeship, with equally weighed obligations and responsibilities to all four bodies; owners, employees, government, and consumers. Among such managing groups will be found individuals who have the professional philosophy in high degree, conducting their affairs for the just and equitable benefit of all four groups concerned, maintaining the health and progress of their institutions as potent agencies for ministration to the needs of the people. They find common ground with the trustees of great foundations, of hospitals, and all non-profit organizations devoted to the public welfare. They find common ground also with many of those who make a career of the business of government. Their ranks are recruited by many in the ordinary walks of business who have seen a light; and envisioned a function in life which is higher in its satisfactions than the struggle of any body against any other; namely a struggle with all bodies to preserve an ideal. Out of this trend, as competition for industrial existence becomes tempered, should emerge a new profession with its own traditions and beliefs, which is capable of managing prosperity so that it will be conducive to the health of a nation; and there is grave question whether this objective can be attained in any other way. I wish there were a special order of knighthood in this country to honor and unite those who are now blazing the difficult path and developing the novel philosophy of this new profession.

Engineering, however, derived jointly from the quiet cloisters of science and from the turmoil and strife of aggressive business, and it is no wonder, therefore, that it should wobble a bit as it seeks to evolve its own professional philosophy. Just as it is not reasonable to expect the young neophyte to grasp at once the idealism of his calling, so it is perhaps not reasonable to expect a profession which is so young and which has grown so fast to have found itself in this regard.

Entrance Into a Profession

The period of initiation into any profession should extend into maturity. Only when members reached the full bloom of manhood did the ancient orders entrust the mysteries to their care. The young neophyte served his apprenticeship under constant tutelage and close guidance by mature minds, and this we still find in every profession. As apprentice, as employee, he is called upon to prove himself; before he enters into that relationship where his opinions are controlling in his special field; and some there are who never emerge from close control and the mere exercise of technical proficiency. In the engineering profession this emergence usually is circumscribed by the fact that most engineers operate as members of industrial organizations of one sort and another, and the fact that they serve their apprenticeship in this same sort of organization and come to devote their entire efforts to its affairs, rather than to enter them after professional recognition elsewhere, as is usually the case with medical or legal individuals. This, however, merely emphasizes the need for better supervision of the neophytes by the members of the engineering profession who have arrived. It is not enough to leave their training to the industrial organizations of which they are junior members. Inculcation of the principles of the profession can come only from those who themselves have attained to a full grasp of its proper function in society, who have arrived at a

balanced judgment as to its responsibility to the several groupings of which society is composed, and who have a professional interest in the young men who are destined to succeed them in the profession. Every profession should have its secrets and its mysteries; spread before the world that all may read, but truly grasped only by those who have lived the professional life; and these should be transmitted to the neophytes with due care, with reverence for their inherent worth, and in due time. Ritual and symbolism, secrecy and circumspection, were the ancient paraphernalias which insured a proper seriousness in youth in order that the impartation might be impressive. These have not wholly disappeared in the modern professions. Admission to the bar, the use of the title of doctor, and similar customs and usages have profound effect in producing a professional consciousness. The engineering profession is wholly without these aids, and its task of inducting its neophytes into the true professional atmosphere is thus rendered doubly difficult.

But does it matter after all? Are the things that engineers do so vital that they must needs be approached in the professional spirit? Most certainly it matters. And most certainly the task is a professional one. The impact of science is making a new world, and the engineer is in the forefront of the remaking. He lights the way in a very literal sense. He brings peoples close together for better or worse, by facile communication and rapid transportation. He guards the food supply, and replaces the hopelessness of Malthus with an embarrassing plenty. He shortens the hours of labor, and fills the consequent leisure with distractions. He temporarily disrupts the techniques of whole industries, and thus alters the life habits of many people, in maintaining a continually rising standard of living. He bores through the earth and under the sea, and flies above the clouds. He builds great cities, and builds also the means whereby they may be destroyed. Certainly there was never a profession that more truly needed the professional spirit, if the welfare of man is to be preserved.

Expression of Professional Spirit

There is no lack of signs of a rising consciousness in this regard. The profession is most positively vocal. There is a vigorous new organization, linking several large groups, devoting itself to the improvement of the education of the young engineer, and the instillation of high principles during his early career. Engineering literature is full of discussions of the duties and responsibilities of the profession, and out of this may crystallize some day a code, a set of principles of conduct, a guide drawn solely with the object of advancing the public weal, which will become accepted by engineers everywhere, whether in government employ, private practice, or industrial organization. Having, to some extent at least, consolidated their techniques, engineers are certainly giving thought and voice to their position in society, and to their responsibility for the use of the great works which they create.

The focus of this whole affair is the American Engineering Council. More than any other group it represents the engineering profession as a whole, in its relationships with government, other professions, and the public. Here, more than in any other organization, reside the external as contrasted with the internal relationships of the profession. It was founded by men who considered its functions in terms of a high idealism. It is now going through a strenuous period of self-examination. To this every individual can contribute only one set of thoughts to be merged with all of those which seethe, and interact, out of which will come in due time that consensus which will form the opinions, traditions, codes, and consciousness which will mold the engineering profession. It will come unless the Council fails; for if it fails, and if its place is not taken by a more rugged successor, there will be no unitary engineering profession at all. In the spirit of adding my few thoughts to those of the eminent men who are directing the Council I have previously offered comments, and I now comment again, with the expectation that I will be disagreed with and answered, with the wish to add my mite to the consummation.

I find it a vigorous and rapidly evolving body. I consider it to be utterly inadequately supported by the profession as a whole, in comparison with the central bodies of sister professions, and with a serious problem as to how adequate support can be drawn for the great task that lies ahead of it. I find it partaking of the great American tendency toward overcomplication, and inclined to attempt things which seem to me personally to be off the main beat. I find to my great joy that it is gradually becoming known and recognized; and I trust this is just a beginning. I find it guided by some of the best minds in the profession as its officers, who are giving valuable time to its cause; and I hence cannot fail to be optimistic as to its future.

To me, however, there is just one point on which I wish to focus attention. I find it struggling with its own philosophy. I find, in fact, that it hesitates as it formulates its idealism; that it has not yet placed its foot unequivocally and irrevocably upon the path that leads to complete devotion to the public welfare. I find that it has not yet enunciated its belief that the great mission of the engineer lies in intelligent, aggressive, devoted ministration to the people. This I urge with all the emphasis I can command.

Necessity for a Central Organization

I do not seek to conjure away practical difficulties by ignoring them. I know full well what restricted budgets mean. The argument that the support of the membership can be obtained only if they can see a direct and personal benefit from their contributions has a familiar ring. I recognize that it is entirely proper for professional men to join in an insistence upon a reasonable and proper recognition of their services to society. Yet if there is no central organization which has as its creed the best service of the profession to the society of which it forms a part, then there will be in the end no engineering profession. Professional status rests in perpetuity, not on transient law, not on the cruder machinations of the

ancient guilds, not on exclusive control of those having a specialized and necessary knowledge; but upon the respect and fundamental support of the people who are served; who only in the long run can insist upon the maintenance of prerogatives, and confer honor, recognition, and special privileges in society upon the members of a profession.

Will engineers support such a program? Will they contribute directly or through their specialized societies to the development of this ideal, and its exemplification in Council projects aimed at rendering real some aspect of the profession's contribution to public welfare? Will they make possible great forums for the crystallization of engineering opinion on public questions involving engineering, not to attain an impossible unanimity or produce high-sounding resolutions, but so that all aspects of controversial matters may be aired in order that people may know what engineers think? Will engineers go along heartily in developing a professional consciousness, a code of action, a philosophy which implements a desire to be a truly professional group, oriented primarily toward the advancement of the public health, safety, comfort, and progress? Will they accept as the central theme the engineers' ministration to society, without fear of any class, and without prejudice toward or away from any special social interests or causes?

If they will not, then there is no truly professional spirit to build upon. We may as well resign ourselves to a gradual absorption as controlled employees, and to the disappearance of our independence. We may as well conclude that we are merely one more group of the population, trained with a special skill, maintaining our economic status by a continuing struggle against the interests of other groups, forced in this direction and that by the conflict between the great forces of a civilized community; with no higher ideals than to serve as directed, and with no greater satisfaction than the securing of an adequate income as one member in the struggle for the profits of an industrial age.

But I know the minds of too many engineers to be thus pessimistic. I recognize the distinguished careers of a generation of men who have practiced in the profession to its credit and honor. Though the task be difficult, on account of the nature of many of our relationships to society, nevertheless traditions are being formed, the consciousness of the membership is becoming aroused, and I confidently expect the profession of engineering to develop in a manner of which we can be justifiably proud.

And to those in the ranks, who may not have yet seen the light, I would preach the doctrine, without pulling any punches, without mincing any words, that the path of professional attainment lies open before them, that it is a thorny path that is easily lost sight of among the rocks and rubbish, that it can be adhered to only by sacrifice and by support of those who lead the way, that it is a long path which leads down into the valley into which the sun does not shine, but that it leads at last to the heights. To the heghts of true professional attainment, where honor and individual recognition by fellows is the real reward, and where the watchword is that old, old theme, which has never lost its power, and which may yet save a sorry world, simple ministration to the people.

An Exciting and Pleasant 40 Years

By F. B. JEWETT
FELLOW AIEE

In accepting the 1939 John Fritz Medal, Doctor Jewett cited a "few fragments" of his history and philosophy

ON OCCASIONS like this it is expected that the medalist say something about his past which presumably he thinks may have borne on the award. Since the matters discussed by the committee of award around the council fire are never disclosed, this is a dangerous thing and one to be invited only by stoics. If the medalist chances to hit on things they have approved, they may be pleased but must wear the mask of vacancy. They must wear it also if he esteems things they consider of little or no merit. It is an irreversible process. I am going to avoid both Scylla and Charybdis by the simple process of crawling overland and dropping a few fragments of my history and philosophy.

As I look back over my life, two things impress me: one is the time and place of my birth; the nature of my education, and the character of the men it has been my good fortune to know and work with; the other is that far from my having anything to do with it, the course of my life has been essentially the antithesis of a planned career. However vigorous I may have been at times in

Essential substance of an address delivered at the John Fritz Medal presentation ceremonies during the AIEE winter convention, New York, N. Y., January 25, 1939.

F. B. Jewett is vice-president of the American Telephone and Telegraph Company and president of the Bell Telephone Laboratories, Inc., New York, N. Y. A biographical sketch of Doctor Jewett appeared in the December 1938 issue (page 521); an article outlining his qualifications for the John Fritz Medal appeared in the March 1939 issue (pages 115–17).

some adventure, in honesty I must confess that I have been essentially a drifter continually taking up the things of the moment that I thought needed to be done.

I have known many men and women. In the main I have found them worthy and have truly liked them. I have found some who were "brass hats" and some who were really great. If I ever had awe for the "brass hat" or for those whose importance inheres in chance occupation of an important position, I have long since lost it. If I ever lacked respect for the truly great or for those who possess any elements of greatness, I have it now and I hope in sufficient measure to override judgment based on those more ordinary qualities we all possess so abundantly.

When I left my California home in 1898 to paddle my own canoe on the stream of life, it was to depart from a community still dominated in its outlook by the spirit of the frontier pioneer. It was an attitude toward life grounded in adventure and social insecurity where men counted for everything and their clothes and the like for but little. No one growing up in such an environment could escape being influenced by it any more than the mavericks could escape the branding iron.

Of course, it was not a canoe I embarked in but the single old-fashioned wooden Pullman which on most days 40 years ago was sufficient to handle all the first class Kansas City and Chicago traffic the Santa Fe could scrape up out of Los Angeles even with the help of a legion of ticket scalpers.

Six years later in Boston when I left active academic life for good, it was to accept a job that I had not sought and in a field I scarcely knew existed until the job was offered to me. It seemed an attractive opportunity to do an interesting piece of work. Strangely enough the wrenching of my academic heartstrings was not particularly painful. Fortunately for me it did not part them, however.

For a number of years this new life in the telephone field was little more to me than a tremendously interesting and exciting technical job. I did not know then how deeply I was to become enmeshed in the philosophy on which the Bell System is grounded nor how far my admiration of that philosophy was destined to carry me into remote fields of education, engineering, the urge to foster the development of scientific research and public service in both war and peace.

Possibly I have overestimated the wisdom of those who 50 years or more ago had great visions and created the pattern of the Bell System. Possibly I have overrated the mechanism they set up to fit that pattern and have placed a too great worth on all the physical and social results which have been the direct heritage of men's thinking and planning five decades ago. It is not so much that I marvel at the visions—we all have those—but that men should have the wisdom to see that realization of their particular vision called for a pattern and mechanism which was iconoclastic. Of course they could not see all the results of their planning and in many respects they built better than they knew.

We who have followed and who have used and improved the tools they created know that great technical achievements which have not been duplicated or approached elsewhere have resulted. We know that this is because of a unique philosophy and setup and not because of any extraordinary prescience on our part. My own work has been mainly in the technical sector where the barriers of distance have been annihilated so far as speech is concerned and where here in America as nowhere else the goal of an ideal telephone service is within sight. I am proud to have had a part in the work.

But my admiration goes much further for I have seen the influence of that wisdom exerted on men and women to develop in hundreds of thousands of them an ideal of public service in which elements of self-interest and mere money grubbing play no dominant part. It is an ideal which makes no hypocritical disclaimer of a proper profit motive as a necessity in the attainment of an ideal service. When the books are finally balanced in the distant future I am not at all sure but that more credit will be given us of the Bell System for pioneering work in the mechanism of relating applied science to the art of living than for all we may have done by way of applying science usefully.

I can speak thus confidently about tens of thousands of my associates whom I have never met because I know of the influences that have operated on me and the results thereof. They have not been the influences created by small thinking in those far-off days.

My expeditions into the fields of education; stimulation of research in the domains both of fundamental and applied science; and public service of various kinds all, in a way, have been collateral offshoots of my main interest.

I have seen great changes in scientific and technical education. From the standpoint of the quantity, quality, and variety of food available, there can be no question as to the advance since my youth. From the standpoint of the cooking and serving there has been improvement though not so striking, I think, except in a trade-school sense and hardly commensurate with the vast amount of conscientious devoted effort expended on it. Still it has improved in a practical way. It is in the sector of true scholarly education, however, that progress seems to me to have been most uncertain. Possibly it is a field in which nothing much can be done since probably the capacity for such education is a result of genes and hormones hardly likely to be changed radically by outside influences.

I cannot but wonder whether our frantic present-day efforts to advertise and dramatize the wares we are prepared to vend at our educational institutions are really incentives to increased scholarship of the kind that really makes for advance in science and engineering as elsewhere. I wonder.

In the domain of research in fundamental and applied science and in engineering, the picture of improvement and results is crystal clear. In a manner of speaking, industrial research in its modern sense has come into being in my active lifetime. It was a hard job to get the load started and wagons up the first long hill—in fact, to find enough horses to pull them over the rutty road. Now, however, with a smooth highway leading apparently downhill into the promised land, there is some danger

that the horses may get run over if the drivers are careless or the brakes fail.

Altogether it has been an exciting and withal a pleasant 40 years for me since I left the orchards and vineyards of southern California to plunge into grown-up life four days later in Chicago through the doorway of 28 degrees below zero and a 60-mile-per-hour northwest wind. I hope I have added something to the pile of worth-while things and that I may add more. Whether or not this hope is justified I do know that in many respects the world of tomorrow which my boys are entering is a much better world than mine was; but there is more to challenge and excite. Even in the field of science and engineering, while we are leaving them a mass of troubles, we are likewise leaving them an improved kit of tools with which to cope with those troubles.

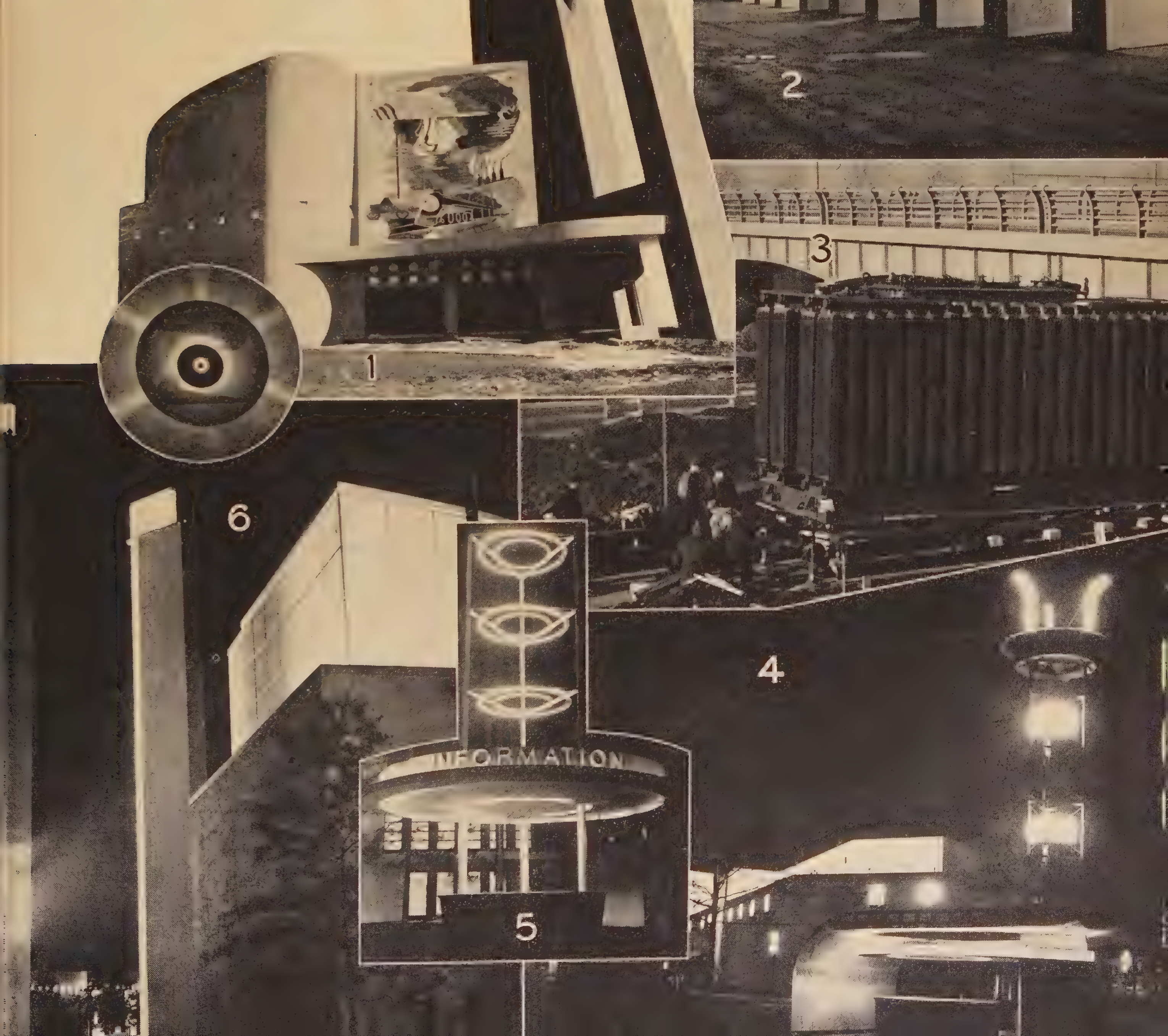
In conclusion I can only express my appreciation for the honor done me and through me the associates in many fields for whom I stand as a symbol. I gladly accept the 1939 John Fritz Medal for myself and as a trustee.

Members Invited to Visit AIEE Headquarters

MEMBERS coming to New York City to attend the World's Fair, or for other purposes, are cordially invited to call at Institute headquarters, 33 West 39th Street, and to take advantage of the opportunities there offered for correspondence, conferences, receipt of mail, and assistance in connection with inspection trips and other matters. Headquarters are in the Engineering Societies Building, the entrance to which, shown in the center, leads directly to the lobby pictured at the left above. Below, right, is the reception lobby of AIEE headquarters on the 10th floor. In the center below is a corner of the members' room and at the lower left the gallery of past AIEE presidents. Members may wish to visit also the Engineering Societies Library, right above, on the 13th floor.

New York World's Fair Will Open April 30

DEDICATED to the theme "building the world of tomorrow" the 1939 New York World's Fair will open April 30 for a six month's run. These few "glimpses" of the exposition illustrate the indispensable part that electricity will play in its operation, and particularly its nighttime illumination. The Electrical Products Building (1) will be of particular interest to electrical engineers. The Business Systems and Insurance Building (2) employs jeweled lighting units. Electric power is supplied from two substations in which are installed seven 15,000-kva 56-ton transformers (3). Fluorescent tube lighting will be used extensively (4 and 5) and many novel luminaires and lighting effects will be in evidence. Two huge pylons, illuminated at night, stand in front of the Hall of Communications (6); one of the novel luminaires, mounted on the side of this building, is shown in the circle.



Standards Activities in AIEE and ASA

• By H. E. FARRER
ASSOCIATE AIEE

APPARENTLY the complexities of the standardization machinery in operation in the electrical field today is continually leading to misunderstandings, particularly among the members of the Institute uninitiated in standards rites. These erroneous beliefs vary all the way from one in which the Institute is pictured as having resigned all interest in standards work, to that where the AIEE is preparing again to take over full control. Both statements are far from the truth and might lead to unfortunate developments. An attempt therefore was made over a year ago through the publication of an article in ELECTRICAL ENGINEERING (June 1937, page 653) to get a clear picture of the situation before the membership. With the same goal in view, this article is now being presented but from a slightly different viewpoint.

Since the days of 1918 when the American Standards Association was established on the basis of a plan formulated by the AIEE, the scope of work of that organization has grown so tremendously that even the simplest outline of all the various undertakings would require a pamphlet of considerable size. Under present procedure the electrical standards committee of ASA, representative practically of the entire electrical field, is essentially the court for American approval of electrical standards. These standards may have been developed under the sectional-committee procedure of ASA, or they may have been entirely formulated and presented for approval to ASA by standards-making organizations similar to the American Society for Testing Materials, the National Electrical Manufacturers Association, or the AIEE. Final action granting approval as American Standard lies of course with the Standards Council which, however, naturally looks to the ASA electrical standards committee for recommendations on electrical matters.

In developing a standard by means of the sectional-committee procedure of ASA, the first step consists of a general survey of the field involved with a view to the selection of the proper bodies to be represented on a "sectional committee" and the selection of a sponsor for the undertaking. The sponsor, holding largely an administrative supervision, may be either one of the interested organizations in the field to be covered, or may be the electrical standards committee itself. The work of standards development from that point on is simply the normal procedure followed by all standards-making bodies. Final approval must be obtained by means of ballot. The recommendation of the sectional committee, together with results of the ballot then goes to the electrical standards committee for examination and approval, leading eventually to the issuance of an American Standard or American Recommended Practice.

Experience has shown that sectional committees can do their most effective work and with a great economy of time, if as the basis of their work a draft standard or a report on a proposed standard is before them. It is in the furnishing of such material that the Institute and other organizations can be of great service. In all cases, where conditions warrant, the Institute has submitted its standards to ASA as the basis of American standards or such other action as is deemed desirable.

The Institute has an ideal setup for the development of standards material, namely, the technical committees, covering all phases of the electrical art, many with active subcommittees. The Institute also has means for immediate and wide circulation of information and data on proposed new developments. This is essential and valuable in keeping standards up to date and in avoiding long delays in final approval of revisions and new developments. In other words, it is the very definite responsibility and duty of the AIEE technical committees to prepare and formulate standards material, developing it to a point where it is satisfactory to the industry. The current procedure then is for an AIEE technical committee to pass this work on to the AIEE standards committee. The standards committee then approves the material, if satisfactory, either for publication in report form, or for transmittal to the ASA for consideration and approval as American Standards. There may be exceptions to this procedure, in which event action should be based on the conditions applying to the particular situation.

In the past the Institute considered as outside its field dimensional standards and other similar questions involving more or less commercial matters. Under ASA all these things may be gathered together and with related test codes and recommendations on operation form complete American Standards—something that never was obtained under AIEE procedure only.

It seems fair to say that the present setup while apparently unduly complicated, actually lends itself admirably to the solution of the varied problems continually developing in the electrical field. Solutions can now be found to situations that at one time seemed hopeless. There is still work for all and plenty of it.

Standards form the basis for a necessary common language for the discussion of electrical machinery and other apparatus, and serve as one of the principal means for getting research results into actual use in industry. Formulation of electrical standards is an important function of the AIEE, which has an ideal setup for their development. Approval as "American Standards" is a function of the American Standards Association, a joint agency of which the AIEE is a "member-body."

H. E. FARRER is a member of the AIEE headquarters staff and has been secretary of the AIEE standards committee since 1923.

Some High Lights in the

Evolution of Electrical-Engineering Education

By DUGALD C. JACKSON
FELLOW AIEE

The award of the AIEE 1938 Edison Medal marked the first time that the term "engineering education" appeared in the formal citation of the recipient's achievements. Hence it appears quite logical that Doctor Jackson, who received the award, should discuss that subject in his acceptance address.

THE CITATION that the Edison Medal committee has so graciously joined with my name couples engineering education with engineering practice. That never before has been done explicitly in an Edison Medal citation. Indeed the phrase "engineering education" never before has been used in such a citation. The use here seems to me significant of the present relation in the field of electrical engineering, where education and practice are now recognized as complementary parts of one whole; and it turns me to the theme of engineering education, to the exclusion (at this time) of directly discussing the science and art of electric-power practice which is the conjoined part of the citation.

In the beginning of the last decade of the 19th century, electrical engineering was young and its devotees likewise mostly were young. As it usually goes in a young art, there was endless opportunity for exercise of the quality of quick creativeness, and therefore those of us who were in it were having all the pleasures and most of the perils of joyous adventure, with the reassuring result that the art was moving forward and expanding rapidly although the movement seemed slow to our ambitious minds. The responsibilities were large, but most of us were young and resilient and bore them satisfactorily as we pushed our way through the thicket of the partly-known or the jungle of the unknown.

While I was in the midst of this absorbing life at the opening of the last decade of the 19th century, there came to me from T. C. Chamberlin, then president of the University of Wisconsin, an invitation to visit him at Madison, the seat of the University—which I did. He offered me the faculty post at the head of a department of electrical engineering just authorized for the university. Madison was beautiful. It had expansive lawns shaded by many oak trees. The lake alone was adequate to fill the eye with beauty. I fell to the charms. The apple went to gain the fair Helen. But in spite of the precedent tribulations of Paris and the downfall of Troy, I never regretted the choice.

Chamberlin was a geologist of great intellectual power. Later as head of the department of geology at the University of Chicago he proved himself one of the nation's great scholars and of international fame. Before his time there had been some mild engineering instruction at the University of Wisconsin, but he gathered together a faculty group to cover the then principal branches of engineering. All of us, I think, had been successful as employees in engineering affairs relating to our respective branches, and some had been additionally proved in experience as teachers. We all were young. Indeed, some of us were scarcely dry behind the ears. I was 26 and head of a newly established department with no precedents to follow therein. It was early in electrical engineering and still earlier in organized electrical-engineering education. It was only six years since bachelor's degrees were conferred for the first time at Massachusetts Institute of Technology and Cornell University, which were the pioneer institutions in establishing formal curricula in electrical engineering. The AIEE itself was only seven years old.

By this time (1891) there were formal electrical-engineering curricula in a considerable number of institutions, but substantially all had been established under the aegis of departments of physics and most of them still were directed by such departments. We were breaking sod in electrical-engineering education because at the University of Wisconsin the department was established at once as part of an engineering school and co-ordinate with other engineering departments. That is the best of practice now, but it was irregular then. We owe a debt to the physicists for starting into electrical-engineering education when they did, but later experience has proved the soundness in education of dealing with it as a coequal branch of engineering.

I refer to these things because they aid in showing the development of a philosophy of education in electrical engineering which seems to me to have had a considerable influence throughout the land. Chamberlin told us that in the great plains area of the United States college teachers of engineering were rather jeered at on the ground of being theoretical and consequently unpractical, and that we must maintain the proof of our competency in engineering. This meant authorization for some practice as consulting engineers, which suited me, because (while I had previously carried responsibilities in engineering work) I could not be content to plan a way in engineering

Essential substance of an address delivered at the Edison Medal presentation ceremonies during the AIEE winter convention, New York, N.Y., January 25, 1939.

Dugald C. Jackson is professor emeritus of electrical engineering, Massachusetts Institute of Technology, Cambridge, Mass. A biographical sketch of Doctor Jackson appeared in the January issue (page 50); an article outlining his qualifications for the Edison Medal appeared in the February issue (pages 64–6).

education without maintaining a continuing intimacy with the advancing front of engineering practice. That was more important in those early days than it is now, but the idea still possesses real vitality when properly applied.

Chamberlin was a scientist and he had an intuitive recognition of engineering as a profession relating to applications of the sciences and as far different from even the highest order of artisanship. He expected us to prove ourselves scientists. We also had to prove a capacity for influencing students, which meant (for those of us who had not already done so) breaking into the art of pedagogy in a limited but important sense. The first of these was relatively easy for those of us who had laboratories or field duties under our control. We were young and full of queries as to why things occurred and about the interrelations of physical phenomena; and we used our students to work out our problems (for which we tried to make them competent) or to strip the ground for us so that we could dig at main kernels more directly. Incidentally, this was good pedagogy when used so as to put our students individually on their mettle, but I do not think we were aware of that. We were enthusiastically satisfying our own curiosity and our students' curiosity about physical relationships. We did get a reputation as a group of young engineers who were also competent young scientists and who attracted to them ambitious and resourceful students. This resulted in our growing group being frequently raided for the benefit of some other universities, to our grief at loss of colleagues, but also to our satisfaction at such recognition of our serviceableness.

Recognition for Engineering Faculty

It was not so easy to gain acceptance in pedagogical lines from conservative members of faculty who cultivated the classics, philosophy, literature, and other humanistic fields. However, various incidents arose that resulted ultimately in our acceptance in full as adequate members of the university faculty, and our relations were very happy. It was about this time that a near neighbor of mine, an authority in classical languages and literature, whom I highly regarded, said that he found me "very well read for an engineer." I had difficulty in convincing him that I could not accept that as the personal compliment for which he intended it because, if I did, it became such a sad reflection on my profession which we were trying to get people to realize is as much a field of learning as (for example) medicine or law.

Our engineering faculty group at the University of Wisconsin promptly went to work in defining our objectives and the programs for advancing toward those objectives. We explicitly formulated the understanding for the four-year undergraduate curricula that the objective was not to make engineers but was to make young men with "a great capacity for becoming engineers," since greatness in engineering usually comes with the years of wide experience. This, in my opinion remains a good aim for the undergraduate curricula of the engineering schools, since too close attention to engineering practice prevents applying sufficient attention in the college to the essential sciences and political economy of which the applications make the structure of engineering. But I completely disagree with those who now urge that the tenet should equally apply to all graduate work in the engineering schools.

Our laboratories became more versatile and our library more extended as we struggled at Wisconsin to develop in our students individual initiative, self-reliance, and resourcefulness by processes of self-education learned by them while absorbing the facts and interrelationships of science and political economy. We were quite unconventional, but the processes worked. The engineering school of the University of Wisconsin grew in a dozen years into quite a reputation for creditable achievements in engineering education. In directing this project of higher education leading into engineering, some of us came to recognize that "There is one glory of the sun and another glory of the moon and another glory of the stars." Also that among teachers and students there could be indeed very few suns or moons, but of stars there might be many; and of them we learned to remember that they may be infinitely varied in their brilliances, their tastes, and their prospective effectivenesses. "One star differeth from another star in glory" also said the Apostle, referring to tangible appearances. We thought of these words, but applied them to the imponderable human characteristics of the individuals. It also led us to the maxim that each member of the growing electrical-engineering staff in the University must be a master in a creative way of some particular aspect of electrical engineering, who also possessed a wide general knowledge and interest in all human activities and particularly in the activities of ambitious young men.

When things were well under way, we started some graduate work in electrical engineering, and perhaps a little in other engineering branches, still with the individuality of the students in mind. Then, after a time we took to reanalyzing the history and developed scope of electrical-engineering education and practice in this country and Europe, with the purpose of criticizing our own processes in the educational field and learning whether our emphases were wisely set. This led us more and more to treasure and encourage student initiative and independence in laboratory work.

Applying Wisconsin Methods at MIT

After $15^1/_2$ years of this fascinating development work, it was my fortune to go to the Massachusetts Institute of Technology in the post of professor in charge of the department of electrical engineering, there to set up the processes established by the Wisconsin experience. At MIT the course was the oldest in the history of electrical engineering, having been established in 1882, and it had a very distinguished background in its more than 600 alumni from 22 classes. Many of the alumni already held important places in the electrical field. The executive committee which controlled the institute for the corporation was composed of devoted and distinguished men, several of them being important men in the electrical

field. It was a stimulating situation and the department, in staff and students, about equalled in numbers those to which the department at the University of Wisconsin had grown; but the equipment was not the equal of Wisconsin's for fertile teaching, and the space was cramped in some of its aspects.

The MIT curriculum had become, with the course of time, overconventional, and the department staff was endeavoring to do too much of itself instead of relying sufficiently on fellow departments in collateral fields like mathematics, physics, mechanics, thermodynamics, and so on; this tended to prevent opportunity for the individual members to become creative masters in their own chosen branches. We promptly revised the curriculum with the object of enlarging student independence and individual vision. We substituted the principle of the continuity (unity) of learning in place of the bit-by-bit dealing with electrical engineering as a series of concrete, inadequately dovetailed parts which was then fashionable and which has not yet been everywhere abandoned; and we cultivated an intimate co-operation with collateral departments.

Valuable Relations With Industry

The great industrial activity of our neighborhood enabled us to cultivate closer relations with the industries than had been practicable in the Middle West, and we gained great advantage from the generous advice and aid of important men in the industrial field. This was important because electrical engineering is largely industrial, if we think of industry as inclusive of the public utilities as well as of manufacturing and its concomitants. I think it also was a stimulus to the growth of that sense of responsibility toward supporting sound engineering education which now is found in various industrial circles. It also ultimately led to the joint establishment of the clearly defined co-operative curricula in electrical engineering (in which MIT and each industry concerned bear mutual responsibility for the educational procedures) which now absorb the attention of over one third of the electrical-engineering students at MIT. In our teachings, we markedly emphasized the research aspects of the higher levels of engineering activities.

Here, as we grew and were granted more space and funds, we came to understand that a suitably directed large department with many students of varied tastes and fine abilities may prove to be more invigorating to the individual students than a smaller department may be. But there are certain restrictions which must be recognized. The department must have allocated for its use both space and funds which, on the basis of per capita of students, are fully equal to those of the small department; and it must have a staff membership which is fully as large per capita of students as characterizes the small department. That staff must be a group of scholarly and creative masters, each leader being a notable specialist in his own subdivision of electrical engineering and characterized by enthusiasm for science and equal enthusiasm for encouraging the independence of students while passing on to them his own best qualities. It is this variety of contacts with notable men available in a well-directed large electrical-engineering department that produces the notable stimulation.

The point which I emphasize is that in engineering education no curse rests on bigness because of bigness any more than either a curse or a blessing rests on smallness because of smallness. In either case, realizing the fullest service for students and for the engineering profession depends on the educational statesmanship coupled with the scientific creativeness of the department. If that combination is adequate, a well-staffed and fully supported large department may be more stimulating to students of high grade than a small department. This applies equally to graduate students and undergraduate students in their individual accomplishments.

Developing Student Responsibility

In such a department the highest success depends on the undergraduate classes being divided into small sections, selected according to the tastes and mental speeds of the students, honors groups being organized with prime responsibility laid on the members for their own education aided by seminars and sympathetic counselors selected from the staff, searching examinations being offered which cover as a unit the entire field studied, large freedom for self-chosen investigation being provided in the laboratories, and (as they advance) the students being encouraged to participate as self-reliant individuals in staff research. By these processes stimulus toward full self-development is equally offered for the infrequent suns and moons and the more frequent stars within a range of brilliancy, as they occur among competent students of engineering. For success in the adventure, each leading man on the staff must have mental qualities that give him strength in science, in scientific research, and in the applications of science, accompanied with strength in pedagogical qualities that lead him to sympathetic interest in the intellectual progress of students; and a spirit of co-operation must be maintained among the staff members, which is difficult in a group of individualistically minded stars.

Such men are difficult to find for the staff. They are far scarcer than men with fine research capabilities in science or men with fine pedagogical capabilities, who do not possess the twin capacity. It has been my fortune to find among my colleagues many such unusual men to whom I am glad to express deep indebtment. I wish I could tell you about them and the manner of their achievements, but that would require a substantial history of the electrical-engineering department of MIT and particularly of its last 30 years, which would be a long lecture of itself. Space protected from the weather, equipment for extemporizing experiments in research, and a properly supported staff of men with the qualities described, under sympathetic leadership and freedom to carry on, will result in a great engineering school anywhere; but not infrequently the proper spirit is not there or the necessary conditions are not provided and the engineering school

is but an aspiring, or (worse yet) an unaspiring, nebula instead of a glowing star in the educational firmament.

A fine, creative department is costly to maintain. A good engineering school spends more money on its productive educational work than it receives in tuition fees from its students, and any university chief executive who believes that a great engineering school can be run at less cost per capita of students than a great medical school, aside from hospital costs, is supporting an unfounded supposition. One fault attaching to our engineering education is that a few of the universities that support medical and various other branches of education on a high level of scholarly fitness are willing to see their engineering schools lie in the neutral space of semiprofessional, semiartisan activities, with minor emphasis given to scholarly and creative qualities. Naturally, such institutions fail to secure (or keep) scholarly men for leaders in their engineering work.

One more word: H. C. Bunner one time remarked, in a burst of characteristic humor, that Shakespeare "lived by writing things to quote." No one will gainsay either the greatness or quotableness of the great poet's writings, or deny that they are much quoted. So I will quote: "A jest's prosperity lies in the ear of him that hears it." That is a saying of truth and is worth remembering. We of this age may paraphrase that and say that a consulting engineer's repute lies in the minds of his clients, and a teacher's contributions lie in the achievements of his students. In these respects the engineer or teacher is but a catalyst and is not a direct factor in the reactions that occur except to stimulate them in the origin, to encourage them as they grow, and to give them range. It is having this in mind that gives me so deep an appreciation of the gift of the 1938 Edison Medal as a thoughtful token that something permanently serviceable has been accomplished.

Some Comments on

Graduate Training for Engineers

Representative industrialists and educators see value in postgraduate training in some situations, but such training cannot be evaluated in advance in terms of individual progress, nor is it in most industrial fields a substitute for actual experience

QUESTIONING the value and adequacy of postgraduate engineering courses as commonly conducted, L. W. W. Morrow in an article in ELECTRICAL ENGINEERING for March 1939, pages 118–22, called for a program of investigation of postgraduate training. Solicited comments of some representative industrialists and educators are presented here.

M. W. Smith MEMBER AIEE

Mr. Morrow has developed a number of questions and made many constructive suggestions regarding the objectives and achievements of graduate training for engineers which deserve careful consideration by those responsible for the planning and execution of this kind of educational work as well as those who are contemplating taking graduate work.

The inference that industry offers no special inducement to men with graduate training is no doubt justified to a large extent, although the value of such men for special advanced assignments like research work is generally recognized and appreciated by industrial management. The justification of a more general use of graduate engineers in industry will depend upon the extent to which their training can be planned and conducted to meet general industrial conditions and requirements. Industry will probably be slow to recognize graduate engineers as a special class for universal application, but as individuals having such training demonstrate its advantages through unusual or extraordinary accomplishments, the value of this kind of training will be appreciated just as other special training, fellowships, and so forth now supported by industry are recognized and successfully applied.

Graduate training is usually conducted along the lines of "more of the same" with the result that about all the student acquires is a greater accumulation of knowledge and information on the particular phase of the subject in which he specialized. This procedure and training, of course, makes the man a more valuable specialist and one who will probably advance more rapidly in his particular line of work.

Such a plan probably does not represent the fullest possibilities of graduate training nor fulfill all the needs of industry. The normal undergraduate training qualifies

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the student with average or exceptional ability to advance satisfactorily through the normal channels of specialized activity in an industrial organization, and it should be recognized that the normal forces of individual competition and demands for maximum efficiency of operation and output naturally tend to confine a man to a relatively limited field of activity in which he is likely to remain if his previous training is entirely of a specialized nature and if he does not broaden his education and qualifications through outside work and training. One of the problems with which industrial management is continually confronted is to find technically trained men with the qualification of leadership required successfully to direct the efforts and activities of others. The qualifications for leadership of course involve human characteristics, personality, and many other factors, but is it not possible that to some extent the deficiency may be influenced by limited views and perspectives resulting from education in restricted and specialized fields even though the training may be basic and fundamental? If this be true, then it would seem that there exists the possibility of enlarging or expanding graduate student training so that in addition to the usual specialized training which is required for the purposes and objectives of most courses, there should be an opportunity to plan and conduct the graduate work so as to broaden its scope in a way that will develop a better conception of the importance of and relation between the various branches of engineering and science. An understanding of more branches of science and an appreciation of their relationship will better prepare the student for observing and absorbing information relative to the varied over-all engineering operations of a particular industry and thus give those who are not content to remain in specialized activities a better opportunity to prepare for and undertake broader management responsibilities.

Because of its vital interest in the training of students, industry would welcome the opportunity to work with college faculties in the consideration and development of plans to broaden and improve the training for graduate engineers along the lines suggested by Mr. Morrow. This is a problem of mutual interest, and a closer relationship providing for a free exchange of ideas and experiences is certain to produce better results.

A. R. Stevenson, Jr. FELLOW AIEE

Mr. Morrow's excellent article is of great value in raising many questions which stimulate thought on the subject of "Graduate Training for Engineers." In a short space there is hardly time to discuss more than two phases of the subject.

1. A few colleges are now turning out doctors of philosophy in engineering that are valuable in industry as technical engineers. These colleges have at least one outstanding professor who, by his excellence in his profession and by his personality and character, attracts the right kind of candidates and gives them training, inspiration, and an opportunity to develop.

According to well-established tradition, James A. Garfield is quoted as saying at an alumni dinner in New York City in 1872:

> My definition of a university is Mark Hopkins at one end of a log and a student at the other.

This is the real crux of the situation. There is too much tendency today throughout both education and industry to put faith in false gods such as organization and facilities. These are important, but they are absolutely secondary and minor compared to the supreme importance of individual inspiration and leadership. Many colleges have put too much money in laboratories, in organization, in curricula, and in hosts of instructors, and then cannot afford to hire the one important element which would motivate the whole as the spirit motivates the body, a professor who is a great man.

The value of the degree of doctor of philosophy in the fields of physics and chemistry has been recognized more widely by industry than the same degree in engineering. The reason perhaps is that these fundamental sciences can more easily be practiced in a college laboratory. The science professors do researches which even though theoretical may be called practical in the best sense of the word because they lead to useful results. The graduate students associating with these professors get the stimulus of helping in real creative enterprises.

The necessity of such practical enterprises as a part of education is indicated in the following quotation from John Dewey's book "How We Think":

> The assumption that information which has been accumulated apart from *use* in the recognition and solution of a problem may later on be freely employed at will by thought is quite false. The skill at the ready command of intelligence is the skill acquired with the aid of intelligence; the only information which, otherwise than by accident, can be put to logical use is that *acquired in the course of thinking*. Because their knowledge has been achieved in connection with the needs of specific situations, men of little book-learning are often able to put to effective use every ounce of knowledge they possess; while men of vast erudition are often swamped by the mere bulk of their learning, because memory, rather than thinking, has been operative in obtaining it.

The doctors of medicine, law, chemistry, and physics get their stimulus largely from men who are practicing their professions.

Engineering has a tendency to deal with projects of such magnitude that it is hard to handle them in a laboratory. The teacher of engineering, therefore, is often not a practicing engineer who can stimulate his pupils by sharing with them real creative enterprises. Graduate work would be greatly benefited if the professors handling it could all be engaged part time in creative work.

2. We have all felt the disappointment of going on a vacation in search of happiness only to find the experience below expectation. Those who search primarily for security are the least likely to get it while the audacious adventurer is resourceful enough to gain security by his own wits. Many, indeed, are the examples of the philosophy that most worth-while things in life are obtained

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best as *by-products* of striving for some other more primary objective. It is true in engineering education. If the student's *main objective* is to learn, he can learn most and quickest by reading the work of others; the better it is explained, the fewer thoughts he need originate and the faster is his progress. That knowledge so gained is of little value to him later is recognized, but, if his primary objective is *to obtain a useful result for someone*, he may have to think enough to fix firmly the knowledge and the fundamentals for future use. A professor who is a current leader in engineering has such problems; he can by his own pre-eminent ability lead and challenge the brilliant student and finally, if he is a true leader, he can inculcate in the student a sense of moral and social responsibility toward mankind, an essential for those who are to shape our technical advance.

In conclusion: Correct graduate education is not primarily derived from well-equipped laboratories or from elaborately prepared curricula, but is a by-product of producing useful results in association with an inspiring leader of outstanding ability on some worth-while pioneering adventure.

I. Melville Stein MEMBER AIEE

Mr. Morrow appears to have taken a fair and square look at both sides of the question, and seems to conclude that engineering colleges should provide graduate training for engineers, provided the program is undertaken in the proper way and only after careful study and planning.

For most of the requirements of the Leeds and Northrup Company, preference is given young men who have spent four years in college and who are then put through the company's own graduate course, requiring approximately one year. However, for research work there is a need for men who have done graduate work in college although the graduate work need not necessarily be in engineering.

I agree with Mr. Morrow that it is difficult, if not impossible, to prove a case for or against graduate study in engineering. That being so, it would seem to me that an experimental approach would be the proper procedure. In other words, if graduate engineering courses could be established in a limited number of engineering colleges and a record were kept of the later achievements of the men taking these courses, a factual basis might be established for determining whether or not such courses are worth while.

As Mr. Morrow has indicated, most major technological advances are now being made by groups of workers rather than by individuals, and under such circumstances, it is a real question whether the best results would be obtained by physicists and engineers co-operating or by a group of superengineers working without the physicists. I am inclined to believe that the former is a better arrangement than the latter, but am willing to admit that the latter group might win out. In other words, it may be difficult to obtain in a single individual, even with extended training, the proper combination of the free imagination of the theorist and the more practical point of view of the engineer.

One thing that appears to be lacking in Mr. Morrow's presentation is a consideration of the response of the students themselves. He states that at least four years should be devoted to graduate study. May there not be a real difficulty in getting the type of man who would make a really good engineer, rather than a pure scientist, to spend eight or more years in training before taking up practical work? Perhaps the answer to this is that what is sought is not really a group of "superengineers," but rather a group of "supertechnologists" or possibly no existing terminology is adequate to label the ideal product of such graduate courses. In other words, a new name may be needed.

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O. W. Eshbach FELLOW AIEE

Agreement with the analysis of the situation and idealism in objectives of graduate study for engineers as discussed by Mr. Morrow, does not justify an acquiescent amen. It implies a challenge to meet a situation which is by no means clearly understood. The paradox in it is that freedom of development of educational methods and facilities has been both the strength and weakness of current practice. One questions whether the opportunities to experiment have been fully grasped or whether unrecognized forces have limited choice and tended toward the development of a pattern that is characterized by expediency rather than ideal objectives. Certainly to judge whether graduate study is justified educationally on the basis of the character of industrial needs is adopting a poor criteria. It implies the act of following rather than leading.

One vital suggestion in the paper would seem a reasonable expectancy in so far as administrative action is needed. It is a decided effort toward better integration of what is now being done but even this implies objectives which are not easy to visualize. There is little doubt that in so far as undergraduate instruction is concerned there is need for a well-balanced and integrated program that permits greater flexibility in later choice of opportunity and at the same time would help to break down the popular conception that one must graduate in engineering with a special designation of proficiency in a traditional branch of engineering which is increasingly less prominent in creative work in life. If such a change could be effected gradually and soundly, the sequel to it would be a possibility of organizing graduate study along the more ideal pattern which Mr. Morrow suggests.

It would be unfair to imply that "learning more and more about less and less" characterizes present graduate study, but the danger is present and leads to personal restrictions likely to be interpreted to the detriment of much needed study in mature years. So long as facilities and conveniences for study while working are undeveloped

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in fields of occupational usefulness, formal study of the type we now have is not far from the most practical, as distinguished from most ideal procedure.

Robert E. Doherty MEMBER AIEE

Mr. Morrow's discussion of graduate work in engineering is the best I have seen. Its presentation of industry's narrow outlook upon the need for men with graduate training, of the discursive and shallow nature of much that is offered or given by colleges as graduate work, and of the inadequacy of faculty personnel fully prepared to lead study at high scientific level is, I think, fair; and I therefore agree that if we accepted present experience and practice as the sole bases for judging the case, we should have few reasons for planning graduate training.

But I also agree that we should look elsewhere for the guiding light. If colleges had been guided in the early stages of engineering education by the prevailing opinion of industry as to the need of college training, they would probably have concluded that work for the bachelor's degree was unnecessary or futile, and that even if some study beyond high school did seem worth while, it should be thoroughly "practical." One does not have to go back to beginnings to find this point of view; it still lingers unbelievably. The prevailing opinion of industry is not a competent guide as to whether high-grade graduate work in engineering is desirable, because very few industries know what it is to have full-fledged applied scientists around the place. I do not mean doctors of philosophy in chemistry or in physics or in any other single field of physical science whose training has hardly touched *applied* science. There are many of these in industrial and educational research laboratories, where they belong, and some of them are doing fine *research* jobs in uncovering basic scientific knowledge. Nor do I mean the usual engineering graduate, who certainly is, in a degree, an applied scientist; nor yet the masters of science in engineering, most of whom are, in this same degree, such scientists. I mean, as I understand Mr. Morrow means, men who really *understand* the basic principles and facts of those aspects of physical science that underlie a broad field of engineering, and who have cultivated intellects—disciplined in those *essential* attitudes and techniques that will make it possible to deal effectively with knotty problems of applied science beyond the boundaries of precedent.

For light we should look not only inwardly, as Mr. Morrow suggests, but as well to a few industries where there are representatives of the kind of applied scientists we have in mind. A few industries have set up educational programs to train such scientists because they could not get them from colleges. To study the methods and experience of these would add greatly to, and I am sure would largely confirm, the idealistic concept of graduate study Mr. Morrow has portrayed. Moreover, if I may offer another illustration, not altogether without prejudice, I would suggest that the program for the doctorate in electrical engineering at Yale University be examined. Whether it will accomplish the purpose for which it was designed is yet to be seen, but it was at least framed with definite end-objectives in view at each stage, and those objectives are almost precisely those Mr. Morrow has specified.

There are, however, two or three points in his plan on which I would comment. One is the extent of factual knowledge required at the start. This should be limited to the utmost minimum required to implement theory, or, as he says, "focus the abstract scientific knowledge." This minimum is still of very large scope, and to settle upon the *minimum essentials* in a rounded-out, integrated program is one of the most difficult educational problems I know. But it is solvable. It must be remembered in any study of this matter that the best place to acquire the specific facts of a specific job or problem is *on the job*. This lesson, by the way, is yet to be learned even in undergraduate work.

Another point is that "the man needed by technological industry must be able to state his variables at the start of a problem. . ." If the problems are of the type I believe the author has in mind, I should regard this as optimistic. I've never seen anyone who could do it and *know* that he had stated them all at the start. But I agree that the more he can identify at the start, the better.

And finally, I think I probably see greater reason than he does for insisting on reasonable literacy regarding the interdependence of social and technological developments. I contend that unless we are content to give merely lip service to the theory of democracy, we should set down as a specification that professional men, especially those in science and engineering, should not be socially illiterate.

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R. W. Sorensen FELLOW AIEE

Mr. Morrow's timely and comprehensive article presents almost every angle of the subject as expressed by many persons of varied experience and attitude toward education who were interviewed by him. Assuming that his title, "Graduate Training for Engineers," means a program of study and research carried on in residence at a technical college by men who have completed a regular four-year college course, I would like to supplement his paper by citing some observations and results within the scope of my own experience.

My first premise is that the art and science of engineering now have reached a stage where graduate schools for engineers are absolutely essential for the continuance of the engineering profession on the high plane it now has, and on the plane which we all desire and which is the goal of the four Founder Societies, the Engineers Council for Professional Development, the Society for the Promotion of Engineering Education, and the National Council of State Boards of Engineering Examiners.

If this point is well taken, the next question is, "Who

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should take graduate engineering courses and what subjects should be included in graduate curricula?" I believe that one-fourth or perhaps one-third the young men now graduating from four-year engineering courses should take at least one year of graduate work. The courses for those who take only one year of graduate work should not differ greatly as to type from the undergraduate upper-division courses of our better engineering colleges; that is, the one-year graduate curricula should include courses which enable the student to get well acquainted with special subjects such as long transmission lines, advanced work in the characteristics of electrical machinery, laboratory work of research nature, and to obtain increased facility in the use of differential equations and other advanced mathematics and physics as applied to engineering problems. If one-fourth to one-third of the engineering graduates from four-year courses continue for a year or more of graduate work, the undergraduate courses may also be improved by deferring some of the special technical subjects now given in the senior year to the graduate school and using the time thus made available in the undergraduate years for the humanities to an amount equal perhaps to 25 per cent of the total time available for study in the four undergraduate years. This may well be done to good advantage for all men taking engineering courses, because the undergraduate courses will still contain sufficient technical content to enable engineering graduates to carry on all the technical work involved in many phases of our profession and at the same time will give the four-year-course men a better general knowledge, thus better fitting them for many semitechnical and management positions than can be done by courses in which practically all the time of the undergraduate years is devoted to technical subjects.

Furthermore, the natural expectation is that the men who will take graduate courses are the men who because of their own desires and superior aptitude in the strictly technical phase of engineering have been encouraged by their teachers to take graduate work. My experience has shown that students mature very much more during their fifth year of work than during any of the four undergraduate years and that they obtain a well rounded grasp of the whole scope of what constitutes the work of an engineer, far in excess—as measured by time spent—of an added college year.

Graduate engineering colleges should also provide for a very select group of men of special ability three or four years of graduate work leading to the doctorate degree. The number of students who can qualify for and profit by this larger amount of graduate work probably is not more than five per cent of the number graduating from the four-year undergraduate engineering courses. Graduate curricula for such men should not be made up, to any great extent, of engineering courses designed to make men more proficient in the same type of technical work as that included in undergraduate courses, but rather the course work of graduate curricula for doctorate-degree engineers should be made up very largely of advanced courses in modern physics and mathematics, which with a bit of economics and chemistry coupled with "tie in" engineering courses and an engineering research problem, constitute a well rounded whole. In order to have such an arrangement function effectively, co-operation is absolutely essential between the science and mathematics faculties and the engineering faculties, so close that all departmental division lines are practically eliminated. Of course, it goes without saying that such a condition can exist only when the colleges concerned have outstanding science and mathematics departments sufficiently staffed by men who know what the engineer is trying to do and who are sympathetic with his program to care for the engineers who wish to take that work.

For 15 years I have had a part in assisting a considerable number of young electrical engineers through graduate engineering courses of this type. During that entire time —which also includes our recent depression years—the demand for men who have completed the work for their doctorate degrees has greatly exceeded the supply. Electrical engineers with doctorate degrees thus educated have been employed at premium starting salaries by colleges and by industry. In fact, the demand for such men and for the men who have completed one year of graduate work by industry has been so much greater than the California Institute of Technology graduates available that Mr. Morrow's statement—"some manufacturing executives say it is foolish for engineering colleges to give graduate work"—gives me no concern.

There is much more I would like to say regarding experiences in conducting graduate work, but to do so would make my discussion as lengthy as the paper.

My second premise is that the engineers who are the leaders in the profession at the time our present college men reach middle life will include many who have taken graduate work even unto the doctorate degree and that the next generation of engineers following these men will find graduate work almost absolutely essential to leadership, to the same degree as it has been so found by physicians, physicists, chemists, mathematicians, biologists, attorneys, and others, all of whom have found that the men occupying the better positions and enjoying the greater professional prestige are the men who for the most part have continued graduate work over a sufficient period to warrant the acquirement of a doctorate degree.

If Mr. Morrow's paragraph which reads as follows:

> As a general conclusion we may say that present graduate work is without completeness or unity in plan or policy; is taught by overworked or incompetent teachers; is without adequate experimental facilities, has relatively few students enrolled and only a few of these are qualified to do the work. We have few reasons to base plans for graduate training upon present experience and practice. There are sound reasons, however, for studying the present situation and building upon the good things found in past experience.

in general is correct, I would like to call attention to the fact that there are a number of engineering colleges to which the statements in that paragraph do not apply. Those colleges have not tried to offer graduate work for large numbers nor have they provided graduate engineering courses until after outstanding science and mathematics departments with courses available to engineering students had been well established. After having thus provided

these proper conditions for graduate work, the colleges I have in mind have established definite policies for graduate work which include unified and complete courses taught by competent and not overworked teachers provided with adequate experimental facilities in the way of laboratory space and equipment. To me it is perfectly clear that colleges which cannot arrange such a graduate program should not undertake engineering graduate work at all, or at least should not plan for more than one year of such work. I make the special classification regarding the one-year course because one year of graduate work, as has been stated, can well be along lines of the undergraduate engineering work, which does not demand correlated extensive graduate science and mathematics courses.

Particularly during the recent ten depression years a year of graduate work has had great value in making a way to employment possible for many men who could not obtain any satisfactory engineering positions at the end of their four-year courses, but who developed greatly during a year of graduate work and obtained at the end of their fifth year in college good engineering positions in places which seemed entirely closed to them at the time of graduation from the undergraduate courses.

Leonard F. Fuller FELLOW AIEE

Mr. Morrow's views are idealistic, as he says, and rightly so, for that attitude is required for progress in the complex problems of education. The continued interest of the engineering profession in the training of young engineers is necessary for the guidance of the educators upon whom rests the responsibility for final decisions in such matters. Because of his teaching experience, Mr. Morrow speaks from first-hand knowledge and impressions, and his ideas are worthy of the most thoughtful consideration. I hope his article will occasion widespread discussion among engineers and educators.

Surely there will be general agreement that graduate study should be under competent men; that the physical plant should be of the best; that it is desirable for teachers of engineering to be active in the practice of their profession; and that some instruction should be by professors in departments outside the college of engineering, such as physics and mathematics. Undoubtedly the training of both undergraduates and graduates should be rigorous and broad within reasonable limits, for excessive specialization produces the man frequently referred to as having learned so much about so little that he knows nearly everything about nothing. But I do not think our leading engineering schools are failing to meet the situation. Present conditions do not justify serious concern over the shortcomings Mr. Morrow mentions.

Let us examine the facts that support this viewpoint and in doing so let us realize that graduate training is merely one of many steps in the life of a successful engineer who will continue to study to the end of his days. His college training, undergraduate and graduate, is primarily for the purpose of teaching him how to study and how to think in the ways that generations of engineers have found necessary and best. If he masters the fundamentals of engineering technology and approach and learns how to make intelligent use of libraries and the information obtainable from other men, the student is equipped to proceed thereafter with further study under his own power in whatever direction the practice of his profession may require.

In well-organized graduate schools, students now have ample opportunity to work under the best men in the departments of mathematics, physics, and chemistry as well as of engineering. In leading colleges the limitations to the graduate training of engineers are not the lack of proper courses, or laboratories, or men. Nor are they to be found in the better students themselves except for the fundamental fact that graduate study cannot, even under the most ideal circumstances, take the place of and develop a man as will the experiences and responsibilities of actual practice. By this I mean that the strongest of faculties, having at its disposal the finest of laboratory and library facilities, could not train the most carefully selected and brilliant students to be well rounded engineers in 4 years or 40 years of graduate study. We must not overlook the human factors of the student himself. Engineering training reaches the saturation point for the best students after three or four years of graduate work following the bachelor's degree. For most students the saturation point is reached much earlier, depending upon the scholastic abilities of the individual, and for many it is reached before the end of a four-year curriculum. The young engineer must transfer from the school of engineering or science to the school of life and engineering experience for continued progress. If he is the right man and has it in him, he will develop as an engineer and a leader of men. If he does not possess the necessary qualifications, he will not advance. His college studies and degrees are not substitutes for performance in industry. Graduate study cannot make him an experienced engineer.

For these reasons industry cannot offer the young man with graduate training, no matter how fine it may be, a starting salary much higher than that paid the four-year graduate, but the superior training of the young engineer with an advanced degree, if he possesses other necessary attributes, will assist him to demonstrate superior ability to his employer and to advance more rapidly in his chosen profession.

Karl T. Compton FELLOW AIEE

After reading Mr. Morrow's article on this subject, I immediately admit two personal reactions: (1) I very largely agree with his general thesis, though not with all of the opinions which he quotes; (2) there are many points in Mr. Morrow's article which arouse in me an instinctive

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desire to discourse at length—a reaction which I shall hold in reasonable check. These reactions are a tribute to the stimulating character of the article.

Consider first the question of "market survey." Undoubtedly a survey of openings for engineers with postgraduate training is an important element in studying the desirable degree of participation by engineering schools in this aspect of engineering education. Such an analysis might show that the supply greatly exceeds the demand in mass, without proving that postgraduate work in some fields and for some types of men might not be the most important contribution which any engineering school could make. There are many situations, which can be easily called to mind, in which the employers are far behind the engineering educators in perspective and recognition of the opportunities and needs in industry. There are other cases in which this situation is reversed. The first point which I would make therefore is that any market analysis, to be of much value, would have to be carefully analyzed with reference to the needs and opportunities of particular situations by men whose vision is far beyond the average, and also that a detailed analysis and not a mere statement of average opinion or average conditions would be significant.

Certain facts of the real or potential market will, I think, be generally admitted. In some fields of engineering, as in the sciences, postgraduate training is now not only desirable but, for many kinds of work, is almost prerequisite. These are generally the types of engineering, like chemical, communications, and electrical, whose development on the heels of science has been most rapid. Other lines of engineering which have been more static, such as civil or mechanical engineering in their most common applications, are not so generally dependent upon more advanced academic training, and undoubtedly in a majority of cases practical experience at work is more valuable than postgraduate training in college except where the objective is some aspect of the profession which is more highly specialized, or developing more actively, or more dependent on mathematical and scientific background. If a mechanical engineer, for example, is to be a draftsman or a routine designer or operator of machinery, I see little value in graduate work; if he is to be an expert in fluid flow or strength of materials or the design and improvement of engines, then he can find in a good postgraduate department of mechanical engineering a great deal of valuable training which otherwise he could secure, if at all, only through disproportionate time and effort. My second point therefore is that the type of engineering activity toward which the student is headed (assuming his own inherent qualifications for this field) determines largely the degree of advantage of pursuing graduate work.

Another related consideration has to do with the organization of industry itself. In a highly organized industry like the telephone industry, the most valuable training for an engineer is probably in mathematics and physics, preferably including graduate work, and in the fundamentals of electrical engineering. The more specialized training for work in the company can be secured more competently and satisfactorily from the standpoint of the company after the young man has taken employment and through close association with the organized group of experts to which he is assigned. In a less highly organized industry however, such as the textile industry, there is relatively little opportunity for a young engineer to secure this type of specialized training from his associates, and here forward-looking educational institutions may provide training for certain advanced types of work far beyond anything likely to be available to the young employee in the industry. These facts again indicate that graduate training has a very important place to meet specific situations and that these situations may vary from decade to decade as industry develops.

Mr. Morrow stated that "there is a realization that the men now most active on the advance fronts of industry are the doctors in physics and chemistry." My observation has been that much of the most valuable research and training in the postgraduate engineering schools has been in the applications of physics and chemistry to the solution of engineering problems and the development of new engineering techniques. Extraordinarily satisfactory results have come from the infiltration of a few good research physicists or chemists into engineering departments where the co-operative attack on engineering problems jointly from the scientists' and engineers' points of view has been exceedingly fruitful. Graduate students, trained in such an atmosphere, have been found to be particularly valuable to industry in developmental work.

I have in mind a young man trained through postgraduate work as a mathematician and mathematical physicist, who then went on with postdoctorate study and research on the quantum theory of magnetism. In view of this highly theoretical background I was later very much interested to hear the head of the development laboratory of one of our great steel companies say that his people had secured more effective practical help from this young man than from any of their other consultants. I know of several other similar cases.

My conclusion is that postgraduate work in engineering can be exceedingly valuable for some situations and for some men. This is particularly true in the line of research and new development where no adequate alternative to postgraduate training exists. To some extent postgraduate training is also a practical necessity because the increasing demands for fundamental training in the sciences and the basic principles of engineering, combined with the enormously expanded scope of engineering knowledge, have made it necessary to go beyond the traditional four years of engineering education in order to secure a working knowledge of many branches of the subject.

If anyone really believes that there is not a market demand for engineers with postgraduate training, let him occupy for a while the presidential chair of an engineering school and talk to the continual succession of practical men from industry who come to request the establishment of specialized and therefore graduate courses in a far wider variety of subjects than any engineering school has considered it wise to undertake.

News

Of Institute and Related Activities

North Eastern District Meeting and Student Branch Convention

FINAL DETAILS are being completed for the North Eastern District Meeting of the AIEE to be held at Springfield, Mass., May 3–5, 1939. Headquarters will be at the Hotel Kimball and arrangements have been made to house those attending in this hotel and other hotels in the city. Springfield, situated in the Connecticut River Valley, is the center of a growing and prosperous industrial area. An attractive program of entertainment, inspection trips, and technical sessions has been arranged by the District meeting committee under the chairmanship of W. O. Henschke.

Entertainment

A stag smoker will be held Wednesday evening, May 3, at the Highland Hotel. An interesting speaker has been secured for this event and in addition a magician and a hypnotist have been scheduled on the program. A buffet luncheon also will be served.

On Thursday evening an informal mixed banquet will be held at the Hotel Kimball with Doctor John L. Davis as the principal speaker.

A women's entertainment committee is engaged in arranging entertainment for the women. A trip to Northampton with luncheon at Wiggins Old Tavern is planned for one day; a trip to Storrowtown is planned for another day; and a visit to the shopping district.

Technical Sessions

Six sessions are being arranged. One of these is a general session with one or possibly two addresses by speakers of national prominence on economics or general subjects of nationwide importance.

Other sessions will deal with industrial power applications, power generation and air circuit breakers, power transmission, and selected subjects. Friday morning will be devoted to two student sessions in which papers will be presented by students from several of the universities and colleges within the District.

Inspection Trips

The East Springfield works of the Westinghouse Electric and Manufacturing Company, the United States Armory, and the many varied industries in and about Springfield afford excellent opportunity for interesting and instructive insight into these industries. Tickets can be obtained at the registration desk and will be 25 cents for each trip; transportation will be provided for those desiring it, at no additional expense. The following schedule has been arranged:

Wednesday afternoon, May 3

1. *Bigelow Sanford Carpet Company, Thompsonville, Conn.* This plant, which is almost a hundred years old, manufactures a full line of rugs and carpets, and is one of the largest plants of its kind in the country.

2. *Stevens Paper Company, Westfield, Mass.* The plant that will be visited manufactures a high-grade kraft paper of extreme thinness, which is used principally as a solid dielectric in the manufacture of capacitors.

Thursday afternoon, May 4

1. *Chapman Valve Manufacturing Company, Indian Orchard, Mass.* This company has two electric furnaces which are used in casting special alloy steels, used in their valves. The furnaces will be in operation during the trip.

2. *Package Machinery Company, Springfield.* This company manufactures a varied line of packing and wrapping machines.

3. *United States Armory, Springfield.* The chief product made here has been the Springfield rifle, and the new semiautomatic rifle is now in production. In addition there is a large museum containing both early and modern weapons of all kinds.

Friday morning, May 5

1. *Westinghouse Electric and Manufacturing Company, East Springfield.* This plant manufactures a complete line of domestic and commercial refrigerators, air conditioning equipment, and small motors for fans, vacuum cleaners, and other appliances.

Friday afternoon, May 5

1. *Fisk Rubber Company, Chicopee, Mass.* This plant, which manufactures chiefly tires, also makes tape, belts, and other rubber products.

2. *Pratt and Whitney Aircraft Corporation, Hartford, Conn.* The various divisions of this corporation manufacture aircraft engines, propellers, and airplanes.

Those wishing to visit either the United States Armory or the Pratt and Whitney aircraft plant must signify their intention by Wednesday noon and be prepared to submit proof of citizenship by a birth certificate or other acceptable means. In lieu of a birth certificate, a certificate from a town clerk stating that the holder is a registered voter, an army or navy discharge certificate, a pilot's license, or a passport will be acceptable as proof of citizenship. Women will not be admitted to the Armory or Pratt and Whitney plant, but may visit the Armory Museum if a sufficient number is interested.

Hotels and Registration

In an accompanying tabulation is given a list of the principal hotels in the city, together with the daily rates, European plan. Students may secure rooms at the

Headquarters for the meeting are at Hotel Kimball, Springfield, Mass.

YMCA, which is adjacent to the meeting headquarters, at $1.00 for one night or $1.50 for two nights. Members should make their hotel reservation directly with the management of the hotel they choose.

Advance registration will greatly assist the committees making arrangements and will avoid congestion on arrival. For this purpose an advance registration card will be sent to members in the District and nearby territory. A registration fee of $2.00 will be charged all nonmembers except Enrolled Students and the immediate families of members.

Committees

District Meeting Committee: W. O. Henschke, *chairman;* C. L. Dawes, vice-president, AIEE; R. G. Lorraine, District secretary-treasurer;

Hotel Rates in Springfield, Mass.

	Kimball	Highland	Charles	Bridgeway
Single—hot and cold water	$2.00, 2.50	$1.50, 2.00	$1.50, 2.00	$1.50, 1.75
Double—hot and cold water	4.00	2.50, 3.00	2.50,3.00	2.50,3.00
Single—with shower				2.00
Double—with shower				3.00
Single—with bath	3.00	2.00–3.00	2.50, 3.00	2.50, 3.00
Double—with bath	5.00	3.50–5.00	3.50–4.50	3.50, 4.00

Tentative Technical Program

Daylight Saving Time

Advance copies of papers will be made available as papers are approved. If ordered by mail, price ten cents per copy; if purchased at Institute headquarters or at the meeting, price five cents per copy. The announcement of the meeting to be sent to members within the District and nearby territory will carry an order form for those who wish to order advance copies of papers.

Wednesday, May 3

9:00 a.m.—Registration

10:00 a.m.—Industrial Power Applications

J. D. Wright, presiding

Turbine-Electric Textile Range Drives, **E. L. Richardson**, General Electric Company.

Characteristics and Power Requirements of Spinning Frames, **E. A. Untersee**, General Electric Company.

Electrical Equipment on Machine Tools, **B. P. Graves**, Brown and Sharpe Manufacturing Company.

2:00 p.m.—Power Generation

Hydrogen-Cooled Turbine Generator, **D. S. Snell**, General Electric Company.

Experience With Hydrogen-Cooled Turbine-Generators, **M. D. Ross** and **C. C. Sterrett**, Westinghouse Electric and Manufacturing Company.

Some Factors in the Mechanical Design of High-Speed Turbogenerators, **S. H. Mortensen** and **J. J. Ryan**, Allis-Chalmers Manufacturing Company.

Mechanical Problems Involved in the Design of Two-Pole Turbine Generators, **C. M. Laffoon** and **B. A. Rose**, Westinghouse Electric and Manufacturing Company.

Thursday, May 4

10:00 a.m.—General Session

J. P. McKearin, presiding

Arrangements are being made for two guest speakers of national prominence to deliver lectures preferably on economic subjects of nationwide importance.

2:00 p.m.—Power Transmission

K. B. McEachron, presiding

Carrier-Current Losses Measured and Interference Minimized on Boulder-Los Angeles Transmission Lines, **J. D. Laughlin**, Bureau of Power and Light, City of Los Angeles, and **W. E. Pakala** and **M. E. Reagan**, Westinghouse Electric and Manufacturing Company.

Dielectric Strength of Porcelain, **P. L. Bellaschi** and **M. L. Manning**, Westinghouse Electric and Manufacturing Company.

Corona Discharge on Rubber-Insulated Cables, **E. B. Paine**, **H. A. Brown**, and **W. P. Tyler**, University of Illinois.

Characteristics of Restricted Ionization and Its Relation to Voids in Insulating Materials, **C. L. Dawes**, Harvard University, and **P. H. Humphries**, Tulane University.

Equivalent Circuit Impedance of Regulating Transformers, **J. E. Clem**, General Electric Company.

Regulating Transformers in Power-System Analysis, **J. E. Hobson**, Westinghouse Electric and Manufacturing Company, and **W. A. Lewis**, Cornell University.

Friday, May 5

9:00 a.m.—Student Sessions

Professor E. M. Strong is arranging for two parallel student sessions, with student members presiding.

There will be a luncheon meeting for the Student Branch counselors and chairmen at the Highland Hotel immediately following this meeting.

2:00 p.m.—Selected Subjects

Recent Developments in Speed Regulation, **C. R. Hanna**, **S. J. Mikina**, and **K. A. Oplinger**, Westinghouse Electric and Manufacturing Company.

Modern Trends of Air Circuit Breakers, **J. W. Seaman**, General Electric Company.

Radio as an Emergency Means of Bridging Gaps in Wire Telephone Lines, **J. G. Patterson**, New England Telephone and Telegraph Company.

Two-Phase Co-ordinates of a Three-Phase Circuit, **E. W. Kimbark**, Polytechnic Institute of Brooklyn.

The Rectifier Calculus, **W. M. Goodhue**, Harvard University.

A New Measuring Instrument for Direct Current, **H. T. Faus** and **A. J. Corson**, General Electric Company.

E. M. Strong, District chairman of student activities; F. A. Farron, L. Wetherill, R. J. Underwood, C. E. Kilbourne, H. D. Griffith.

Technical Program: F. R. Longley, *chairman;* L. C. Packer, J. W. Bennett, A. L. Davis, O. A. Browne, C. D. Brainard, F. Rogers, O. L. Riggs.

Student Sessions: E. M. Strong, *chairman;* E. A. Walker, A. G. Conrad.

Transportation and Trips: R. E. Curtis, *chairman;* J. N. Alberti, J. W. Bennett, J. M. Newton, A. Blair, D. L. Ross, J. Carson, L. C. Packer.

Entertainment: B. W. Durfee, *chairman;* J. J. Finn, A. Blair, J. N. Alberti, J. M. Newton.

Women's Entertainment: Mrs. J. J. Finn, Mrs. L. P. Kongsted, Mrs. W. O. Henschke, Mrs. H. D. Griffith, Mrs. R. E. Curtis, Mrs. F. R. Longley, Mrs. F. E. Haskell.

Hotels and Registration: H. Passburg, *chairman;* J. N. Alberti.

Publicity: W. S. Scheering, *chairman;* R. R. Menard, Q. A. Brackett.

Finance: F. E. Haskell.

CCIF 1936 Proceedings. An English translation of the proceedings of the Comité Consultatif International Télèphonique at its eleventh plenary meeting in Copenhagen, Denmark, June 11–20, 1936, has been prepared and published by the technical staff of the International Standard Electric Corporation. The CCIF, an advisory body on which are represented telephone administrations throughout the world, is concerned with promoting and co-ordinating international telecommunication. Among the subjects considered at the 1936 meeting were important advances in carrier-on-cable, rating of telephone performance, and preparation of guiding principles for a general European toll-switching plan. The present volume deals specifically with changes and additions to the proceedings of the previous (Budapest 1934) meeting, without duplicating information already published. Other features are an index covering the 1936 and 1934 proceedings, a bibliography of over 1,200 English, French, and German publications, a list of CCIF recommendations in force January 1937, and a summary of recommendations made at the 1938 meeting in Oslo, Norway, many of which are already provisionally in force, pending approval in 1940. The book, uniform with preceding volumes, contains 338 pages, is priced at $2.50, and may be obtained from the general technical department, International Telephone and Telegraph Corporation, 67 Broad Street, New York, N. Y.

Two Districts Announce Branch-Paper Awards

Prize for Branch paper was awarded by AIEE District 5 (Great Lakes) to Wendell C. Morrison (Enrolled Student) University of Iowa, for his paper "Synthetic Inductance," presented April 23, 1938, during a joint session of the District committee on student activities and the Tri-School (University of Illinois, Purdue University, and Rose Polytechnic Institute) Branch meeting, at Urbana, Ill.

By District 9 (North West) prize for Branch paper was awarded to Roy W. Warburton and W. Wallace Murdoch for their paper "An Investigation of Some of the Properties of a Non-Linear Circuit," presented at a meeting of the University of Utah Branch, May 23, 1938.

Future AIEE Meetings

South West District Meeting
Houston, Texas, April 17–19, 1939

North Eastern District Meeting
Springfield, Mass., May 3–5, 1939

Summer and Pacific Coast Convention (combined)
San Francisco, Calif., June 26–30, 1939

Great Lakes District Meeting
Minneapolis, Minn., September 27–29, 1939

Middle Eastern District Meeting
Scranton, Pa., October 11–13, 1939

Winter Convention
New York, N. Y., January 22–26, 1940

Plans Progressing for

AIEE Summer and Pacific Coast Convention

By virtue of its location in San Francisco, Calif., the AIEE 1939 combined summer and Pacific Coast convention, to be held June 26–30, affords unusual opportunities to combine business and pleasure. The Golden Gate International Exposition, recently opened on Treasure Island in San Francisco Bay, will be the principal "extra curricular" attraction. (An article describing electricity's part in the operation of the exposition appears elsewhere in this issue.) The San Francisco Bay area is noted for its many beautiful homes, fine golf courses, and natural attractions such as famed Muir Woods, a virgin grove of giant redwoods. Within a day's drive are many noted resort areas including Del Monte and the Monterey Peninsula, Santa Cruz, Yosemite Park, Lake Tahoe, and the Redwood Highway.

The convention committee is making extensive arrangements for entertainment, sports, trips, and recreation. The business features of the convention will begin with the annual meeting of the Institute to be held Monday, June 26. This meeting will be followed by the conference of officers, delegates, and members, technical sessions, and a general session. The technical program tentatively arranged is broad in scope, embracing the following subjects: protective devices, communication, instruments and measurements, electrical machinery, power transmission and distribution, industrial power applications, electronics, basic sciences, research, automatic stations, lighting, and transportation. In addition, a joint session with the Institute of Radio Engineers is under consideration.

In addition to the foregoing, the 1939 convention will depart from the usual summer-convention tradition and will include student activities on the program. Two sessions are to be devoted entirely to student papers, and separate conferences to discuss student activities are being scheduled. Special accommodations for students will be available at reasonable rates. An unusual opportunity thus is being offered to students to participate in the convention, the inspection trips, and the entertainment features, and also to visit the many Pacific Coast attractions.

Entertainment for women guests is being planned by a special committee with Mrs. S. J. Lisberger as chairman. In addition to scheduled trips and entertainment, the women's committee will arrange, whenever requested, special parties to visit the Golden Gate Exposition, and for shopping, sightseeing, and bridge.

Convention headquarters will be in the Fairmont Hotel. Since hotel accommodations in the city are expected to be in great demand throughout the summer, because of the Golden Gate Exposition, members are urged to make early reservations. Accommodations and prices for the principal hotels in San Francisco are indicated in an accompanying tabulation, and also will be shown in a circular to be mailed to Institute members early in May. Members are urged to make prompt use of the coupon that will be part of that circular; those wishing to make earlier reservations should write directly to E. A. Crellin, Chairman, Hotel Committee, 245 Market Street, San Francisco, Calif., indicating the hotel of their choice, accommodations desired, date of arrival, and names of party members.

Golden Gate bridge from midspan, showing sodium-vapor luminaire and standard. The tops of the main towers are 746 feet above sea level

Further details pertaining to the convention program and its various features will be announced in the May issue.

Special Railroad Facilities

For those traveling from New England and the Atlantic Seaboard region the New York Central System offers special accommodations with connections at Chicago, Ill., and St. Louis, Mo. Arrangements can be made for going and returning via any of the diversified routes west of Chicago and St. Louis, and stop-over privileges can be arranged at almost any point desired. For full information and arrangements write to T. A. Smith, passenger representative, New York Central System, 466 Lexington Avenue, New York, N. Y. Special sleeping cars will be operated from New York to Chicago, picking up additional members en route, in the following schedules, for the exclusive use of members attending from the East:

Wednesday, June 21, or Thursday, June 22

New York, N. Y., and Boston, Mass., to Chicago, Ill.

Commodore Vanderbilt

Leave New York.................... 3:20 p.m.
Leave Harmon...................... 4:06 p.m.
Arrive Albany...................... 5:59 p.m.

Boston and Albany *New England States*

Leave Boston......................12:50 p.m.
Leave Worcester.................... 1:55 p.m.
Leave Springfield................... 3:07 p.m.
Leave Pittsfield..................... 4:34 p.m.
Arrive Albany...................... 5:40 p.m.

Commodore Vanderbilt

Leave Albany...................... 5:59 p.m.
Leave Schenectady.................. 6:29 p.m.
Leave Utica........................ 7:55 p.m.
Leave Syracuse..................... 8:54 p.m.
Leave Rochester....................10:21 p.m.
Leave Buffalo......................11:25 p.m.

Thursday, June 22, or Friday, June 23

Arrive Chicago..................... 7:30 a.m.

Connections at Chicago and St. Louis

The trains of the New York Central System connect at Chicago with all western railroads; the following selection of routes has been offered:

Chicago and Northwestern—Union Pacific—Southern Pacific Route via Omaha and Ogden

Overland Limited

Thursday, June 22, leave Chicago......10:25 p.m.
Sunday, June 25, arrive San Francisco.. 8:25 a.m.

Chicago, Burlington, and Quincy—Denver and Rio Grande Western—Western Pacific Route, via Denver, Gore Canyon, Salt Lake City, and Feather River Canyon

Exposition Flyer

Friday, June 23, leave Chicago........ 3:00 p.m.
Sunday, June 25, arrive San Francisco..10:10 p.m.

Santa Fe Route via Grand Canyon and Los Angeles

Grand Canyon Limited

Thursday, June 22, leave Chicago......10:00 a.m.
Saturday, June 24, arrive Grand Canyon 8:00 a.m.
Saturday, June 24, leave Grand Canyon. 8:20 p.m.
Sunday, June 25, arrive San Francisco.. 9:15 p.m.

Chicago, Rock Island and Pacific—Southern Pacific Route, via Kansas City, Tucson, Phoenix, and Los Angeles

Golden State Limited

Thursday, June 22, leave Chicago......10:15 a.m.
Sunday, June 25, arrive San Francisco.. 9:00 a.m.

From St. Louis, Mo., roads with which connections are made are the Missouri

Principal Hotels in San Francisco, Calif., and Rates

Hotel	City Blocks From Headquarters	Single Room	Double Room	Suites
Fairmont	0	$4.00 to 8.00	$6.00 to 12.00	——
Bellevue	7	——	4.50 to 6.00	$10.00 to 12.50
Mark Hopkins	Across street	6.00 to 7.00	8.00 to 12.00	15.00 to 25.00
Plaza	5	5.00	6.00	——
Stewart	5	3.00 to 3.50	4.50 to 6.00	——
St. Francis	4	4.00 to 6.00	6.00 to 12.00	——

All rates are per day for room with private bath. All hotels can easily be reached from headquarters by street car.

Pacific, Missouri, Kansas and Texas, Cotton Belt, Frisco Lines, and others.

Convention Committee

The personnel of the 1939 summer and Pacific Coast convention committee is as follows: S. J. Lisberger, *general chairman;* D. I. Cone, *vice-chairman;* G. C. Tenney, *secretary;* R. O. Brosemer, *treasurer;* F. S. Benson, A. M. Bohnert, C. F. Bowman, C. B. Carpenter, O. B. Coldwell, P. M. Downing, C. E. Fleager, L. F. Fuller, L. R. Gamble, David Hall, N. B. Hinson, J. P. Jollyman, R. E. Kistler, H. J. MacLeod, J. A. McDonald, P. J. Ost, G. E. Quinan, C. E. Rogers, E. F. Scattergood, R. W. Sorensen, H. A. Stingle, and F. E. Terman. Subcommittee chairmen: M. S. Barnes, *registration;* R. J. Cobban, *sports;* H. W. Flye, *entertainment and reception;* E. A. Crellin, *hotel;* F. R. George, *trips and local transportation;* J. S. Moulton, *publicity;* Stanley Rapp, *transportation;* H. H. Skilling, *student activities;* and W. C. Smith, *program.*

AIEE Executive Committee Meets at Headquarters

A meeting of the executive committee of the American Institute of Electrical Engineers was held at Insitute headquarters, New York, N. Y., March 6, 1939, in place of the regular meeting of the board of directors.

Present: John C. Parker, chairman, C. R. Jones, K. B. McEachron, and W. I. Slichter, members of the committee; C. R. Beardsley, director; H. H. Henline, national secretary.

Executive committee action on applications as of February 21, 1939, was reported as follows: 3 applicants transferred to the grade of Fellow; 8 applicants transferred and 5 elected to the grade of Member; 66 applicants elected to the grade of Associate; 79 Students enrolled.

A report of a meeting of the board of examiners held February 16, 1939, was presented and approved.

Disbursements in February, amounting to $27,448.57, were reported by Chairman Jones of the finance committee and approved.

Authorization was given for the organization of a Mansfield Section of the Institute.

Upon the recommendation of the committee on communication and the technical program committee, approval was given for the holding of a joint session with the Institute of Radio Engineers during the combined summer and Pacific Coast convention of the AIEE in San Francisco, June 26–30, subject to concurrence by the summer-convention committee.

As recommended by the standards committee, a Test Code for Apparatus Noise Measurement, which had been prepared under the auspices of the subcommittee on sound of the standards committee and was a revision of the test code which was printed in a preliminary form in the September 1937 issue of Electrical Engineering, was approved for publication.

The executive committee confirmed the tentative acceptance by the president of an invitation to appoint a representative of the Institute to serve on a joint committee of leading military and professional societies, which was being organized for the purpose of holding a National Industrial Preparedness Dinner in New York on the evening of April 5, 1939. Past President F. B. Jewett was appointed by the president as such representative.

As requested by the Institution of Electrical Engineers, the national secretary was empowered to make the necessary arrangements for the presentation to Doctor W. D. Coolidge, at an Institute meeting, of the Faraday Medal, recently awarded to him by the IEE.

Report was made of the attendance of President Parker and National Secretary Henline at the annual meeting of the Engineering Institute of Canada, in Ottawa, Ont., February 14–15.

Other matters were discussed, reference to which may be published elsewhere in this issue or in future issues of Electrical Engineering.

A view in Cascade Valley, Calif., with Mt. Isaac Walton in the distance. This is typical of many scenic spots that may be enjoyed by those attending the AIEE 1939 combined summer and Pacific Coast convention

AIEE Members Invited to World Automotive Congress

A coast-to-coast program features the 1939 World Automotive Engineering Congress of the Society of Automotive Engineers, in which AIEE members have been invited to participate. Opening in New York, N. Y., May 22, for a five-day session, the congress will proceed to Indianapolis, Ind., to attend the 500-Mile International Sweepstakes on May 30, hold meetings in Detroit, Mich., May 31 to June 2, and close with a three-day session in San Francisco, Calif., ending June 8.

Various aspects of aircraft development will be among the automotive engineering problems considered by the congress, with many of the papers presented by European authorities; 35 foreign governments and over 30 technical societies abroad have been invited to take part in the program.

The five-day technical program in New York will include sessions on aircraft, aircraft engines, fuels and lubricants, passenger cars, passenger car bodies, transportation and maintenance, trucks, busses, and railcars, Diesel engines, and tractor and industrial power equipment. No technical sessions are scheduled for the Indianapolis visit, but members will have opportunity to inspect the mechanisms of the cars that will take part in the race. At Detroit delegates will inspect operations at various automobile plants and attend a technical session at the General Motors proving ground. Sessions on aircraft, transportation and maintenance, fuels and lubricants, and Diesel engines will be held during the final three days at San Francisco.

Both the New York and San Francisco expositions are honoring the delegates to the Congress, May 24 having been designated "World Automotive Engineering Day" at the New York World's Fair, and the week of June 5, "World Automotive Engineering Congress Week" at the Golden Gate International Exposition.

Any Institute members interested in attending the congress may obtain detailed information from the Society of Automotive Engineers, 29 West 39th Street, New York, N. Y.

To Institute Members Planning Trips Abroad

Members of the Institute who contemplate visiting foreign countries are reminded that since 1912 the Institute has had reciprocal arrangements with a number of foreign engineering societies for the exchange of visiting member privileges, which entitle members of the Institute while abroad to membership privileges in these societies for

a period of three months and members of foreign societies visiting the United States to the privileges of Institute membership for a like period of time, upon presentation of proper credentials. A form of certificate which serves as credentials from the Institute to the foreign societies for the use of Institute members desiring to avail themselves of these exchange privileges may be obtained upon application to Institute headquarters, New York. The members should specify which country or countries they expect to visit, so that the proper number of certificates may be provided, one certificate being addressed to only one society.

The societies with which these reciprocal arrangements have been established and are still in effect are: Institution of Electrical Engineers (Great Britain), Société Française des Électriciens (France), Association Suisse des Electriciens (Switzerland), Associazione Elettrotecnica Italiana (Italy), Koninklijk Instituut van Ingenieurs (Holland), Verband Deutscher Elektrotechniker E. V. (Germany), Norsk Elektroteknisk Forening (Norway), Svenska Teknologforeningen (Sweden), Stowarzyszenie Elektrykow Polskich (Poland), Elektrotechnicky Svaz Ceskoslovensky (Czechoslovakia), The Institution of Engineers, Australia (Australia), Denki Gakkwai (Japan), and South African Institute of Electrical Engineers (South Africa).

AIEE Members Invited to Paris Television Meeting

A meeting of a section of the Société Française des Électriciens for the presentation and discussion of a comprehensive series of papers on television by French engineers is to be held in Paris during a week in November 1939. The Société has invited members of the AIEE to attend the meeting and participate in the discussions. The papers will be published in the Bulletin of the Société after the meeting, and copies will be sent to American engineers who attend.

Institute members who expect to attend the meeting are requested to notify the national secretary who will transmit the information to Paris.

27 North Electric Men Apply for AIEE Membership

As an outgrowth of the formation of the Mansfield (Ohio) division of the AIEE Cleveland Section, 27 employees of the North Electric Manufacturing Company, situated in the neighboring city of Galion, have applied for membership in the AIEE. Names of the applicants were posted in the "Membership" department of the March issue.

When the Mansfield division was organized last December (*EE, Jan. '39, p. 39*) the five members of the Institute in the North Electric Company took a very active part in the new division's affairs. These five men, F. R. McBerty, H. F. Herbig, H. O. Whiteley, W. E. Ballentine, and J. M. Robinson, brought a number of the prospects to the meetings and helped to interest them in joining the Institute. When the membership drive got under way in the company, J. P. M. Blackhall, one of the applicants, headed up the activity, contacted all the prospects, and saw that all the blanks were filled out. It is noteworthy that Mr. McBerty, president of the company, was so vitally interested in the Institute that he arranged to have the company pay the entrance fee for each of the applicants.

When the Mansfield division was first organized there were 32 members in the area being served. Including the North Electric group, a total of 35 applications has been secured to date, bringing the total number of members and applicants in the Mansfield area to 67.

AIEE Members Invited to High-Voltage Conference

Members of the AIEE have been invited to attend the tenth meeting of the International Conference on Large High-Voltage Systems (Conference Internationale des Grands Réseaux Électriques, called CIGRE) which will be held in Paris, France, June 29–July 8, 1939.

The 15 sessions, with no parallel sessions, will be devoted to the presentation and discussion of papers on the manufacture and maintenance of machinery, construction, and maintenance of stations and lines, interconnection, networks, and other problems in the generation, transmission, and distribution of electric power. Some 110 papers from 20 different countries will be presented and discussed during the nine days of the conference, which will be attended by some of the most eminent specialists from the various countries.

Membership in the conference is open to electrical engineers from all over the world, and full benefit of the papers and discussions will be available to any person speaking English, French, German, or Italian. The last meeting, which was held in 1937, was attended by 1,175 individuals from 46 countries. Institute members who expect to attend the 1939 meeting are requested to notify the national secretary, who will transmit the information to the headquarters in Paris.

Committee Formed to Study Corrosion. The American Co-ordinating Committee on Corrosion has been organized by a group of engineering and technical societies to serve as a clearing house for information on corrosion and its prevention. The committee, on which 18 societies are represented, was formed at a meeting held February 17, 1939, at the headquarters of the American Society for Testing Materials in Philadelphia, Pa. AIEE representative on the committee is H. S. Phelps (A'21) engineer, special investigation and testing division, Philadelphia Electric Company, Philadelphia, Pa. Permanent organization will be effected at the next meeting, to be held at Atlantic City, N. J., in June, during the annual meeting of the ASTM. C. L. Warwick, secretary-treasurer of the ASTM, is temporary chairman. The committee's first work will be the compilation of a list of those working in the field of corrosion in the United States, with information on their special interests and current programs of studies.

Membership—

Mr. Institute Member:

It is gratifying to report that 705 new applications were received for membership during the month of February, of which applications 573 have come from Enrolled Students who have just begun their professional careers. At the time of this writing the returns continue to be satisfactory.

These returns indicate the great value the young engineer recognizes in the Institute and assure continued healthy growth of our organization.

I wish to express my sincere appreciation to every member who has in any way, large or small, through his personal feeling of loyalty and interest in furthering the advancement of our profession, assisted in encouraging some of these new members to affiliate themselves with the American Institute of Electrical Engineers.

C. L. Webb

Chairman, National Membership Committee

Future Meetings of Other Societies

American Electrochemical Society. Spring convention, April 26–29, Columbus, Ohio.

American Institute of Chemical Engineers. 31st semiannual meeting, May 15–17, Akron, Ohio.

American Institute of Mining and Metallurgical Engineers. 22nd national open hearth convention, April 26–28, Cleveland, Ohio.

American Physical Society. 227th meeting, April 27–29, Washington, D. C.

American Society for Testing Materials. 42nd annual meeting, June 26–30, Atlantic City, N. J.

American Society of Civil Engineers. Spring meeting, April 19–22, Chattanooga, Tenn.

American Society of Heating and Ventilating Engineers. Semiannual meeting, July 4–6, Mackinac Island, Mich.

American Society of Mechanical Engineers. Semiannual meeting, July 10–14, San Francisco, Calif.

American Society of Refrigerating Engineers. Spring meeting, May 21–22, Hershey, Pa.

Edison Electric Institute. Technical committees meeting, May 1–4, Chicago, Ill. Annual meeting, June 5–9, New York, N. Y.

Institute of Radio Engineers. Joint meeting with American Section of the International Scientific Radio Union, April 28 and 29, Washington, D. C.

National Electrical Manufacturers Association. May 14–18, Hot Springs, Va.

National Fire Protection Association. Annual meeting, May 8–12, Chicago, Ill.

Society for the Promotion of Engineering Education. 47th annual meeting, June 19–23, State College, Pa.

Society of Automotive Engineers. World Automotive Engineering Congress, May 22–28, New York, N. Y.; May 29–30, Indianapolis, Ind.; May 31–June 2, Detroit, Mich.; June 6–8, San Francisco, Calif.

World Congress of Mathematicians

An International Congress of Mathematicians will be held in Cambridge, Mass., September 4–12, 1940, at the invitation of the American Mathematical Society. Headquarters of the congress will be Harvard University and Massachusetts Institute of Technology, and neighboring institutions also will co-operate. Support for the congress is being furnished by the Carnegie Corporation, the Institute for Advanced Study, the National Research Council, and the Rockefeller Foundation.

In addition to invited addresses and sectional meetings for presentation of short papers, the technical program will include conferences of specialists in fields of mathematics where important advances are currently in progress. Membership in the congress is open to all, at fees of $10 for regular membership and $5 for associate membership. Detailed information may be secured from the American Mathematical Society, 531 West 116th Street, New York, N. Y.

The first International Congress of Mathematicians was held at Chicago, Ill., in connection with the Columbian Exposition in 1893. Since then meetings have been held approximately every four years, except during the World War, but all have been in Europe, except the 1924 Congress which was held in Toronto, Ont., Canada. The average attendance at recent congresses has been about 600, representing some 40 countries.

Physics Institute to Hold Temperature Symposium

Because so many of the methods used for measuring and controlling temperature in industry are electrical in nature, many AIEE members will be interested in a symposium on "Temperature and Its Measurement in Science and Industry" to be held under the auspices of the American Institute of Physics. Tentative plans are to hold the meeting from November 2 to 4, 1939, in New York, N. Y.

According to present plans, the primary purposes of the symposium are to: (1) coordinate the treatment of the subject in the sciences and branches of engineering; (2) review principles and bring up to date the record of recent work; (3) accumulate contributions for a comprehensive text, to be published as soon as possible after the symposium is held; (4) reveal the subject as an important branch of physics; and (5) supply schools with the information required for the improvement of curricula.

Those interested in taking part in this symposium should communicate with the American Institute of Physics, 175 Fifth Avenue, New York, N. Y., at an early date, giving information regarding their field of work and the subject of the contribution they wish to make. Such contributions will be co-ordinated with the subjects of a group of invited papers, and assignments and divisions made.

Directory of Research Laboratories. Data on 1,769 research laboratories of manufacturing firms and technical consultants are contained in the sixth edition of the directory of "Industrial Research Laboratories," recently issued by the National Research Council. The directory, NRC Bulletin Number 102, contains 270 pages, including indexes. The price is $2.50 in paper; $3.00 in cloth. Council headquarters are at 2101 Constitution Avenue, Washington, D. C.

Current Items From American Engineering Council

Incomes From Independent Professional Practice

The National Bureau of Economic Research has published a preliminary analysis of some of the results of a study of income from professional practice conducted over a period dating from 1929. The report is an intensive analysis of data collected by the Department of Commerce in its studies of national income.

Five professional groups are covered: Physicians and surgeons, dentists, certified public accountants, lawyers, and consulting engineers. The first section of the bulletin presents the average levels of net income in the five professions for a series of years. The most striking fact in this analysis is that the average income of consulting engineers, approximately a third higher than that of the next highest in the year 1929, drops sharply in three years to the lowest average income.

The average incomes of all the other four professions, while falling sharply with the exception of the dental profession, do not reach as low an average. This drop is noted in the report as follows:

> The precipitous fall in the incomes of consulting engineers relative to those received in the other professions is not surprising. To a far greater extent than in the other professions the demand for the services of engineers comes from industries notoriously subject to violent cyclical fluctuations in activity—the construction and heavy industries in general. And consulting engineers are in an even more vulnerable cyclical position than engineers as a whole, since their services are required in larger part in connection with the initiation of new projects or the expansion of existing enterprises
>
> The demand for the services of the other professions is much broader and is not concentrated in any one group of industries or final consumers. The broad pattern of change in their average net income resembles closely that in the average income from employment of all gainfully occupied persons.

AEC Forum Proceedings Available

To meet the demand for copies of the AEC forum discussions, a limited supply of the proceedings on the six subjects presented and discussed last year are available as follows:

1. Employment and the Engineer's Relation to It—48 pages—15 cents.

2. Invention and the Engineer's Relation to It—48 pages—15 cents.

3. Public Affairs—Four Forums—64 pages—25 cents.

I—National Planning and the Engineer's Relation to It.

II—Economic Status of the Engineering and Kindred Professions.

III—Engineering Aspects of Government Reorganization.

IV—Engineering and Economic Factors in the Size of Business

Over 2,000 copies of the proceedings of the first two forums have been distributed to government officials, public institutions, editors, and member organizations.

Engineering Foundation

New Monograph Published in Alloys of Iron Series

Latest addition to the series of research monographs on alloys of iron is "The Alloys of Iron and Nickel: Volume I—Special-Purpose Alloys" by J. S. Marsh, physical metallurgist and associate editor, alloys of iron research, The Engineering Foundation. Like its predecessors, it is published in New York, N. Y., by the McGraw-Hill Book Company for The Engineering Foundation, which is a joint agency of the Founder Societies. This monograph is the tenth in a series of critical summaries of technical information on iron and its alloys, prepared under the supervision of the iron alloys committee of the Foundation. Although the AIEE is not officially represented on the committee, Wilfred Sykes (A'09, F'14) of the Inland Steel Company, Chicago, Ill., is a member-at-large.

The amount of technical literature on iron-nickel alloys necessitated dividing the study into two volumes, the second of which is in preparation. The first deals with the constitution and properties of high-purity iron-nickel alloys and the properties of special-purpose alloys; the second will be concerned chiefly with the engineering properties of nickel steels and cast irons. A bibliography of more than 600 items is included in the present volume.

Of the 13 chapters, 4 are of particular interest to electrical engineers as dealing respectively with "Magnetic Properties of Iron-Nickel Alloys," "Magnetic Properties of Complex Iron-Nickel Alloys," "Mechanomagnetic Properties," and "Electric Properties." The author's preface points out that while much of the discussion is now of interest only to the communications industries, in time some of the materials considered may be used in power transmission also, if their higher cost as compared with present magnetic materials is overcome by greater efficiency.

Letters to the Editor

CONTRIBUTIONS to these columns are invited from Institute members and subscribers. They should be concise and may deal with technical papers, articles published in previous issues, or other subjects of some general interest and professional importance. ELECTRICAL ENGINEERING will endeavor to publish as many letters as possible, but of necessity reserves the right to publish them in whole or in part, or reject them entirely.

ALL letters submitted for consideration should be the original typewritten copy, double spaced. Any illustrations submitted should be in duplicate, one copy to be an inked drawing but without lettering, and the other to be lettered. Captions should be furnished for all illustrations.

STATEMENTS in these letters are expressly understood to be made by the writers; publication here in no wise constitutes endorsement or recognition by the American Institute of Electrical Engineers.

The Student Engineer and "Electrical Engineering"

As I have been reading the February ELECTRICAL ENGINEERING, I have been impressed with the thought that the requests of those members of the Institute who have been asking for a student page or section in ELECTRICAL ENGINEERING have been granted many-fold. Every article in the February number is of interest to and understandable by student engineers who have reached their senior year in college. Moreover, most of the material in this number is so free of dependence upon historic and mathematical background as to be readily appreciated and understood by, and even interesting to, every engineering student from the freshman class up. In fact, I think the number from cover to cover presents material of value to all who expect to be, now are, or have been engineers, be they freshmen, seniors, graduate students, technicians, designers, or executives. Moreover, ELECTRICAL ENGINEERING for a period of several months preceding the February 1939 number and dating back almost to the time of the adoption of the present publication policy, has contained papers of general interest for all engineers, younger and older alike.

ELECTRICAL ENGINEERING, in thus fulfilling the long expressed desire for more papers of interest to student engineers has, without the establishment of a special student section, achieved a goal of much greater value than the mere printing of the desired papers; this goal being the elimination of the appearance of a barrier between student engineers and practicing engineers who are known as Associates, Members, or Fellows. In other words, should we not endeavor to free our minds of any ideas that tend to make engineers think that the profession of engineering comprises men who live a sort of "caterpillar-butterfly" life, one stage of which comprises student life and the other stage the life of the practicing engineer, with little in common for the two stages?

In speaking of the engineer in college I have used objectively the term "student engineers," rather than "engineering students," because I am of the opinion that student engineers should not consider their college years as a time of preparation for life, but rather should realize that the years spent in college are some of the richest years of their entire lives. Student engineers while in college have greater opportunity really to live at a higher level of ideals, ambition, tempo, and capacity for work and play than will be possible for most of them during the years between graduation and arrival at their goals of recognized professional proficiency.

My third-of-a-century's contact with student engineers leads me to believe that the student in an engineering college whose after-life proves him an engineer is not in college because he wants to be an engineer, but is in an engineering college because he is already an engineer with the engineer's craving for a better knowledge of engineering lore. Such being the case, should he not be taught that his college years are a part of his engineering life and not just preparation for a future engineering career?

Lest there be some readers who still feel that ELECTRICAL ENGINEERING should have a separate section for Student Branch papers and news, may I state that during the time I have been chairman of the committee on Student Branches, and before I fully realized all the present publication policy of ELECTRICAL ENGINEERING is doing for student engineers, I felt obligated to see to it that ELECTRICAL ENGINEERING print each month as much material of interest to student engineers as possible. Having gained, in my experience as a board member, a first-hand knowledge of the practical difficulties involved in having a separate student news department, I endeavored to establish informally, without such a department, the publication of news and papers designed particularly for student engineers. This endeavor took the form of requests to some members of the Institute for articles and papers written particularly for student engineers. In some instances I suggested the subjects for the papers, but always left opportunity for those of whom papers were requested for choice of subject matter. To date not one person thus invited to write a paper has seen fit to accede to the request made, though some of those who were requested to write these papers have during the current year been authors of papers which can be read with profit by all Institute members. The results of this experiment, together with my knowledge of previous similar efforts, have convinced me that a special student section—were it wise or, in the opinion of our members, necessary—could not depend upon practicing engineers for regular or perhaps even an intermittent supply of special papers prepared for students.

Also, I well recall the failure of previous attempts which have been made to gather from student engineers the material for such papers. In fact, my own experience includes knowledge of several unsuccessful endeavors on the part of student prize committees to assemble papers for competition for student prizes, regional and national.

Some advocates of a student department have not had in mind student papers or papers written particularly for students, but have thought that a report page telling of Branch meetings, with their attendance records, subjects discussed at the meetings, speakers available, and other matters of news nature would be of value, if published on a student page. As chairman of the committee on Student Branches, I receive weekly from Student Branch secretaries the reports of Student Branch meetings. As I have checked these over, I have noted with interest the similarity of meetings at the various colleges, the approximate con-

stancy of attendance, and other activities at the colleges, and have come to the conclusion that, interesting though all these are, the month-to-month account conveys the impression of a country-newspaper type of news item about as interesting as: "Mr. and Mrs. John Doe journeyed to Jimtown last Saturday and Sunday to visit their son Henry." In fact, if my memory serves me correctly, a few years ago there was a Student Branch section giving news of this type which soon received so little attention that the idea was abandoned.

As a concluding word, therefore, may I ask the readers of this letter to give thought to the fact that the pages of ELECTRICAL ENGINEERING are open to all of its members of whatever grade, student engineers included, who wish to submit material for publication; and to the idea of trying to create in the minds of our older engineers and student engineers alike, the realization that electrical engineers are engineers from the time they decide to enter engineering college, if not sooner, and so long as they live, think, and act as engineers in serving their fellow men through the practice of some phase of the electrical-engineering profession.

Yours very truly,
R. W. SORENSEN (A'07, F'19)

(Professor of electrical engineering, California Institute of Technology, and chairman, AIEE committee on Student Branches)

The Paradox of Social Progress

To the Editor:

Three long letters to the editor in the February issue testify to the sustained interest in the problems presented by Doctor Doherty under the above title. The table of contents for the same issue bears witness to editorial appreciation of the widespread interest among engineers in similar problems. The January issue contained a valuable contribution by President Karl Compton of Massachusetts Institute of Technology on the same general theme, for which it might be profitable to coin one standard generic title. Under the same title might be grouped a large number of contributions to *Mechanical Engineering* in recent years. These addresses and articles by such a large number of leaders in the profession must command the careful attention and consideration of engineers, scientists, and educators.

There is one aspect of the general problem, which may be termed for purposes of reference "The Social Responsibilities of Engineers and Scientists" which seems to have received scant attention throughout the prolonged discussion. In the interests of brevity extended quotations may be omitted, so one taken from Doctor Doherty's article ("The Paradox of Social Progress") may be selected as a text.

In any case we face the evident fact that, even with our present rate of technological development, the consequent growth in complexity of social relationships has already surged beyond our understanding.

Each day reveals fresh evidence of this. Most of the councils in which important matters of national concern are being settled are not distinguished by a comprehensive understanding of the problems considered, and by rational thought. What does distinguish them are strategy, show of force, emotion, and oratory.

This summary diagnosis of a most unfortunate situation may be accepted as essentially accurate. It suggests to me one important contribution which scientifically trained engineers might make to alleviate the confusion in which their fellow citizens, trained otherwise, find themselves enmeshed.

Doctor Doherty might find a place for the missing factor by amplifying items 3 and 4 in his five-point summary, page 447, column 2, paragraph 3, ELECTRICAL ENGINEERING, November 1938:

3. The ability to organize thoughts logically and with purpose.
4. The ability to use the English language and thus express their thoughts effectively.

Much of the spectacular success credited to demonstrated achievements in the fields of science and engineering may be explained by the relatively easy exercise of these two abilities in relatively limited fields, in contrast with the greater difficulties encountered in the more complex fields of human affairs.

However, a more sanguine attitude toward the future may be maintained by remembering that in one field of human affairs these same two abilities have played a conspicuous part in the development of civil law; and that, for centuries at least, civil law is perhaps the most continuous and reliable thread upon which advances in civilization have been strung. In order to complete the outline of "The American Dream" in his closing paragraph perhaps Doctor Doherty might have added a tribute to two essential factors in American cohesive progress. These are the Constitution of the United States and the institution and history of the Supreme Court. To these two factors a group of farseeing and well-educated men entrusted the future of the nation, and their foresight has been justified and endorsed by history. They exercised the abilities indicated in 3 and 4 with wisdom, and with a courage which did not take refuge under a plea of the complexity of human affairs. It seems to me that the engineering profession has been somewhat timorous in following that courageous leadership.

While freely recognizing the values of unambiguous precision in natural laws and their expression, in conventional units and standards in patents, in specifications and in contracts, they have not managed to sell their belief in their tools to nontechnical contemporaries. Had engineers demonstrated more convincingly the extent to which the gifts which they brought to a prospering civilization were dependent upon the rigorous technique to which engineers and scientists must perforce adhere in their dealings with natural laws perhaps the "strategy, show of force, emotion, and oratory" of which Doctor Doherty complains might not have attained their present preponderance in "the councils in which important matters of national concern are being settled."

The unique value of the "engineering approach" to such matters will not be convincing to the nontechnical until the leaders of thought with engineering and scientific training demonstrate that, in nontechnical as in technical matters, they can co-operate in presenting a single united front as spokesmen of the profession.

Without awaiting a plausible pretense of infallibility, or even of complete unanimity, they must be prepared to speak with one authoritative voice on the basis of the best premises available in the form of temporarily undisputed facts, even if these must be adopted by convention as are technical standards.

No exposition, however logical, can convince or receive lasting, reliable endorsement, which has not first secured agreement as to the premises upon which the exposition is based. This is the prerequisite from the omission of which the majority if not all of the contributions to this discussion seem to suffer. A promising and more truly scientific approach to the very interesting and important problem would start with a thorough co-operative effort to rectify the omission indicated.

Very truly yours,
CAMPBELL MACMILLAN (A'08, M'35)

(Research Engineer, Motor Department, General Electric Company, Schenectady, N. Y.)

Technical Progress and Social Development

To the Editor:

Doctor Compton, in his article "Technical Progress and Social Development," states several principles of management. First: Management is an essential attribute of decent group life. Second: Wise management involves the minimum of control. "The problem today," he says, "is to determine the most advantageous balance between the two."

Assuming that such a point could be determined, how could the balance be maintained? Since the tendency is for management to expand its activities, such a condition of unstable equilibrium could only be maintained by a body having dictatorial powers. This would be in direct opposition to our accepted principles of government.

A less optimistic view is that of a society commencing with little or no management. The seed of management is planted and soon it flourishes, spreading its branches so that more and more phases of the society come under its influence. At some point in the development of the society, the elusive balance between control and freedom is reached and the "greatest number receive the greatest good." However, management continues to flourish like a weed and soon its influence is universal. At first the members of the society seek relief from control in the small periods of freedom left them. Soon the burden is too great and they free themselves in one great determined effort only to plant the seed again in the new society which rises from the debris of the old.

The humor in the situation is that Man with his great vanity will not admit the inevitability of this cycle, and it is just as well for him that he does not.

Yours very truly,
IRWIN HAUPT

(Electrical Engineer, 138 South Ninth Street, Philadelphia, Pa.)

Personal Items

J. F. Calvert (A'27, M'35) has been appointed head of the electrical-engineering department at Northwestern University, Evanston, Ill. Doctor Calvert was born October 14, 1898, at Columbia, Mo. In 1922 he was granted a bachelor's degree and in 1924 the degree of electrical engineer from the University of Missouri. In 1930 he received the degree of master of science and in 1936 doctor of philosophy from the University of Pittsburgh. In 1923 he entered the training course of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., and from 1924 to 1936 was employed in design and development work on large a-c machines with that company. From 1928 to 1935 he also served as a graduate lecturer in electrical engineering at the University of Pittsburgh. From 1936 to 1938 he was an associate professor at Iowa State College, Ames, before going to Northwestern University as professor of electrical engineering. He is the author or co-author of papers on various electrical-machinery subjects, and has been granted several patents concerned with high-voltage generators and machine protection from electrical transients.

Shiv Narayan (A'10, M'13) has retired from the principalship of the College of Engineering, Poona, India. Born in Delhi, India, in 1883, Professor Narayan received the bachelor of science and master of arts degrees from the University of the Punjab, Lahore, India, and from 1907 to 1909 was sent to the United States as a state scholar by the Jammu and Kashmir Durbar. During that period he worked in the testing department of the General Electric Company at Schenectady, N. Y., and attended Union College, from which he was graduated in electrical engineering in 1909. He served in the electrical department of the Jammu and Kashmir Durbar from his return from the United States in 1909 until his appointment as assistant professor of electrical engineering at the College of Engineering, Poona, in 1913. He was promoted to the grade of professor in the Indian Educational Service in 1920 and in 1938 he was appointed principal of The College of Engineering, a position which he held until his recent retirement. He is the author of four books in the field of electrical engineering. The trustees of Union College, Schenectady, N. Y., have recently voted him the honorary degree of doctor of science, to be awarded in June 1939.

W. A. Furst (A'13, M'27) has been appointed full-time co-ordinator of navy and maritime activities for the Westinghouse Electric and Manufacturing Company with headquarters at East Pittsburgh, Pa. A native (1892) of Maryland, Mr. Furst was graduated from the University of Maryland with the degree of bachelor of science in electrical engineering in 1912 and received the degree of electrical engineer in 1915. From 1914 to 1917 he was employed by the Consolidated Gas, Electric Light and Power Company of Baltimore, Md. He was an electrical engineer with the Emergency Fleet Corporation in Washington, D. C., and Philadelphia, Pa., from 1917 to 1919, when he was employed as an electrical engineer by the Lockwood Greene Company of Boston, Mass. Since 1920 he has been associated with the Westinghouse company, as general engineer, manager of the engineering division, Detroit, Mich., and manager, central engineering district, Pittsburgh, Pa. Before his recent appointment he was general contract manager at East Pittsburgh, Pa. He is currently chairman of the AIEE Pittsburgh Section.

E. A. Casey (A'27, M'31) has been appointed division manager for the West coast by Anaconda Wire and Cable Company. He will have headquarters at San Francisco, Calif., and supervision of the San Francisco, Los Angeles, Seattle, and Denver territories of the company. Born in Philadelphia, Pa., in 1897, Mr. Casey served in the World War and studied physics and mathematics at the Sorbonne, Paris, France, on a War Board permit in 1919. He received the degree of bachelor of science in electrical engineering at the University of Pittsburgh in 1925. Before becoming a sales engineer for Anaconda Wire and Cable Company, New York, N. Y., in 1929, he had been employed by Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., Union Switch and Signal Company, Swissvale, Pa., Duquesne Light Company, Pittsburgh, Pa., and American Brass Company, Waterbury, Conn. He has since been district engineer in charge of sales engineering for the eastern seaboard district of the Anaconda company, and before his recent appointment was district manager at Denver, Colo.

Jesse Marsten (A'26) has been appointed vice-president of the International Resistance Company, Philadelphia, Pa. He will continue in his capacity as chief engineer of the company. Born in Austria in 1897,

JESSE MARSTEN

Mr. Marsten received the degree of bachelor of science from the College of the City of New York in 1917. He was employed by the Marconi Wireless Telegraph Company of America from 1917 to 1920, working in the testing laboratory, engineering, and research departments. In 1923 he was employed in the technical department of the Radio Corporation of America, New York, N. Y., and in 1925 he entered the engineering department of Freed-Eisemann Radio Corporation, Brooklyn, N. Y. Later he was a radio engineer for the Earl Radio Corporation, Clifton, N. J., before becoming chief engineer for the International Resistance Company.

H. W. Neblett (A'15, M'21) has been elected a director of the Association of Iron and Steel Engineers. Mr. Neblett is engineer, new equipment design and application, Inland Steel Company, East Chicago, Ind. He attended Dickinson Normal College and studied electrical engineering at the University of Tennessee. In 1909 he entered the employ of the Lexington Railway Company, Lexington, Ky., as a repairman on cars and motors. In 1910 he went with the Commonwealth Edison Company at Chicago, Ill., as an operator of substations and served that company in various capacities until 1917. From 1917 to 1921 he was assistant electrical engineer with the Mark Manufacturing Company, Indiana Harbor, Ind., later going to the Chicago office as an electrical engineer with the Steel and Tube Company of America, successor to the Mark Company. From 1922 to 1928 he was engineer in charge of electrification with the Colorado Fuel and Iron Company, Pueblo, and from 1928 to 1932 he was head of the Neblett Engineering Company in Chicago. He became affiliated with the Inland Steel Company in 1932.

E. A. Baldwin (A'07) has been awarded the gold medal of the American Chamber of Commerce in France for distinguished service. Mr. Baldwin is vice-president and general manager of the International General Electric Company, Paris, France, and was president of the American Chamber of Commerce in France from 1934 through 1937. A native (1874) of Hyde Park, Mass., Mr. Baldwin was employed by the General Electric Company, Schenectady, N. Y., in 1896, after receiving the degree of bachelor of science from Massachusetts Institute of Technology. In 1899 he became an electrical engineer for the company's foreign department and was later made assistant manager of the department. Later he became manager of International General Electric, with headquarters at Schenectady. He has been vice-president at the Paris office for about ten years.

C. R. Beardsley (A'08, F'30) has been made manager of the contract control and inspection department of the Consolidated Edison Company of New York, Inc., New York. Mr. Beardsley was born in Bridgeport, Conn., in 1885 and received the degree of bachelor of philosophy in electrical engineering from Yale University in 1905. He was employed by the General Electric Com-

pany 1905 to 1911 at Schenectady, N. Y., New York, N. Y., and New Haven, Conn.; as sales agent by the United Illuminating Company, Bridgeport, Conn., 1911–18; and as electrical engineer by Fred T. Ley and Company, Springfield, Mass., 1918–23. He became electrical construction engineer for the Brooklyn Edison Company, Inc., Brooklyn, N. Y., in 1923, and later general superintendent of distribution construction. In 1938 he was transferred to Consolidated Edison of New York as assistant manager of the contract control and inspection department. Mr. Beardsley is a director of the Institute, and a member of several committees.

A. H. Morton (A'24) has been elected a vice-president of the National Broadcasting Company, New York, N. Y. He will continue as manager of the NBC operated stations department. A native (1895) of Chicago, Ill., Mr. Morton received the degree of bachelor of science from the University of Illinois in 1917. He served as lieutenant and later as captain of field artillery

A. H. MORTON

in the United States Army during the World War. In 1919 he was employed by the General Electric Company as an assistant to the chairman of the board, and from 1920 to 1921 was an assistant to one of the vice-presidents. He became Washington, D. C., representative of the Radio Corporation of America in 1921, commercial manager of RCA Communications, New York, in 1923, and European manager for RCA, with headquarters in Paris, France, in 1929. He returned to New York in 1934 to become business manager of the NBC program department, and assumed his present duties with NBC in 1937. Mr. Morton is a chevalier of the Legion of Honor.

F. S. Haberly (M'32) consulting engineer, has moved the permanent offices of his organization from Worcester, Mass., to Chicago, Ill. A native (1895) of Indiana, Mr. Haberly was employed by the General Electric Company, Fort Wayne, Ind., from 1914 to 1916, and then by the Fort Wayne and Northern Indiana Traction Company. After overseas service during the World War as an officer in the United States Army, he joined the staff of R. M. Feustel, consulting engineer, working on valuation of public utility property. During the next ten years he continued in valuation work for various utility companies and in 1929 became principal assistant in charge of valuation work for Albert S. Richey, consulting engineer, Worcester, Mass. At Mr. Richey's death in 1936, Mr. Haberly succeeded to his consulting practice.

J. S. Murray (M'31) has been elected a director of the Association of Iron and Steel Engineers. Mr. Murray is chief electrical engineer, Follansbee Brothers Company, Follansbee, W. Va. He started electrical construction work in 1913 for the Hellyer Electric Company, East Liverpool, Ohio. In 1915 he entered the employ of Moyers-Bennett Company, Wheeling, W. Va., as foreman of construction on electrification of the eastern coal fields. In 1917 he went with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., working in the research and sales department. From 1919 to 1921 he did consulting engineering work at Pittsburgh, after which he was appointed electrical engineer for Follansbee Brothers at Toronto, Ohio. In 1928 he was placed in charge of all Follansbee plants.

P. B. Garrett (A'24, M'30) has been appointed northwestern district engineer of the Westinghouse Electric and Manufacturing Company, with headquarters in Chicago, Ill. After receiving the degree of bachelor of science in electrical engineering from Colorado State Agricultural College in 1922, Mr. Garrett entered the graduate student course of the Westinghouse company at East Pittsburgh, Pa. In 1923 he became a member of the general engineering department there, and in 1924 he was transferred to San Francisco, Calif., as general engineer for the west coast offices of the company. He was appointed engineering supervisor of the San Francisco office in 1927. Transferred in 1937 to the Salt Lake City, Utah, office of the Westinghouse company as engineering representative, he held that position until his recent appointment.

Nathan Schnoll (A'28) has organized Industrial Instruments, Inc., with headquarters at Bayonne, N. J. Mr. Schnoll is president and chief engineer of the new

NATHAN SCHNOLL

organization. A native (1904) of New York, N. Y., Mr. Schnoll attended the College of the City of New York. From 1922 to 1924 he was employed by the Western Electric Company, New York, as a tester, and for the following year did engineering research for Selco Radio Laboratories, joining the engineering department of F. A. D. Andrea, Inc., Long Island City, N. Y., in 1925. Later he became assistant chief engineer for Polymet Manufacturing Company, New York. Until his recent resignation he was chief engineer for Solar Manufacturing Company, New York.

A. Y. Taylor (A'37) has opened offices at Clayton, Mo., under the firm name of A. Y. Taylor and Company, consulting engineers. Mr. Taylor was graduated from Union College in 1929 with a bachelor of science degree in civil engineering, and later, took graduate work at Massachusetts Institute of Technology. In 1928 he was employed by the McIntosh and Seymour Corporation, Auburn, N. Y., as an erector of Diesel engines, and in 1929 was made tool designer and engineer. From 1932 to 1935 he did engineering work with the Potomac Electric Power Company, Washington, D. C. In 1936 he became associate engineer and later regional engineer with the Rural Electrification Administration in that city.

David Levinger (M'30) has been appointed assistant to the vice-president and works manager of the Hawthorne Works of the Western Electric Company at Chicago, Ill. A native (1887) of Idaho, Mr. Levinger was educated at Chicago Technical College, and was employed by International Harvester Company as a steel inspector for three years. In 1910 he went with Western Electric as a mechanical engineer, becoming assistant technical superintendent in 1920, assistant superintendent of development in 1922, and superintendent of manufacturing development in 1925. From 1928 until his present appointment he was engineer of manufacture.

H. C. Hart (A'33) has opened offices for the practice of patent law at New York, N. Y. Mr. Hart received a bachelor of arts degree from Princeton University in 1922, a bachelor of laws degree from Harvard University in 1925, and the degrees of bachelor of science (1931) and master of science (1935) from the University of Pennsylvania. From 1925 to 1928 he was engaged in the general practice of law in Philadelphia, Pa., and in teaching and research in electrical engineering at the University of Pennsylvania from 1931 to 1934. In 1935 he became associated with Pennie, Davis, Marvin, and Edmonds, New York patent attorneys.

H. T. Faus (A'24, M'34) development engineer, General Electric Company, Lynn, Mass., was one of 18 employees of the company to receive the Charles A. Coffin award for achievement in 1938. He developed a number of new instruments, including some for aircraft engines, which have commercial importance for the company. Mr. Faus, who received the degree of electrical engineer at Syracuse University in 1921 and was employed for the following year by the Simplex Surface

Contact Company, Williamsport, Pa., went to the West Lynn plant of General Electric as a student engineer in 1922.

J. A. Johnson (A'24) was honored at the annual banquet of the National Electrical Manufacturers' Association, held in New York, N. Y., February 9, 1939, with presentation of a certificate for 50 years of active service in the electrical industry. Beginning in 1888, Mr. Johnson was engaged in the installation and operation of electric plants in several Indiana communities. With E. Kuhlman, he founded the Kuhlman Electric Company, at Bay City, Mich., in 1894, and has served as its secretary, treasurer, general manager, and president, all of which offices except the first he now holds.

Daniel Connolly (A'37) has been appointed inspector of light and power in the department of water supply, gas, and electricity of the City of New York, N. Y. He was formerly employed by Maurice Scharf, consulting engineer, after completing a fellowship in the electrical-engineering department of the College of the City of New York.

A. W. Robertson (A'27) has been appointed chairman of the committee on national defense and industrial mobilization of The National Association of Manufacturers. Mr. Robertson is chairman of the board of the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

Dale Pollack (A'37) has been awarded a Charles A. Coffin Fellowship by the General Electric Company for advanced scientific research. He will continue work toward his doctorate at Massachusetts Institute of Technology on a study of frequency modulation in radio communication.

M. D. Hooven, Jr. (A' 24, M'30) has been appointed assistant transmission and substation engineer of the Public Service Electric and Gas Company, Newark, N. J. Formerly a transmission engineer, Mr. Hooven has been with the company since 1922.

W. W. Dunlop (A'38) has been appointed junior engineer in the telephone and telegraph division at Beverly Hills, Calif., by the California Railroad Commission. He was formerly employed as installer by the Pacific Telephone and Telegraph Company at San Francisco.

G. B. Thomas (A'10, M'16) was elected vice-president of the Middle Atlantic section of the Society for the Promotion of Engineering Education for 1939. He is personnel director of Bell Telephone Laboratories, Inc., New York, N. Y.

Hidemichi Rokkaku (A'30) has been elected an editorial secretary of the Institute of Electrical Engineers of Japan for 1939 and 1940. He is an electrical engineer in the Electrotechnical Laboratory of the Ministry of Communications, Tokyo, Japan.

J. V. Lamson (A'29) is now an assistant engineer on the Bonneville Project, Portland, Ore. He was formerly an instructor in the college of engineering, University of Washington, Seattle.

R. P. Ballou (M'37) has become assistant development engineer in the electrical division of Colt's Patent Fire Arms Manufacturing Company, Hartford, Conn. He formerly was employed by the Allen-Bradley Company, Milwaukee, Wis.

G. I. F. Theriault (A'32) is now a welding engineer with the Frigidaire division of General Motors Corporation, Dayton, Ohio. He was formerly an electrical engineer with The Federal Machine and Welder Company, Warren, Ohio.

Gano Dunn (A'91, F'12) has been appointed to represent engineers on a committee to study the relation of civil service to legal and technical positions. He is president of the J. G. White Engineering Company, New York, N. Y.

Ryoichi Masaki (A'13) has been elected a vice-president of the Institute of Electrical Engineers of Japan for 1939. He is managing director of the Mitsubshi Electric Manufacturing Company, Ltd., Tokyo, Japan.

B. F. Wells (A'25) has been appointed assistant mechanical engineer at the Raritan Arsenal, Metuchen, N. J. He was formerly employed as an electrical draftsman by the Bureau of Power and Light, Los Angeles, Calif.

Hideo Yamashita (A'35) has been elected an executive secretary of the Institute of Electrical Engineers of Japan for 1939 and 1940. He is an assistant professor in the electrical engineering department of Tokyo Imperial University, Tokyo, Japan.

F. D. Egan (M'34) has been appointed chairman of the standardization committee of the Association of Iron and Steel Engineers for 1939. He is electrical superintendent of Bethlehem Steel Company, Lackawanna, N. Y.

Wray Dudley (A'12, M'15) has been appointed chairman of the welding engineering committee of the Association of Iron and Steel Engineers for 1939. He is electrical superintendent of National Tube Company, McKeesport, Pa.

W. H. Taubert (A'29) has been employed in the sales department of the Phelps Dodge Copper Products Corporation, New York, N. Y. He was formerly sales manager of the insulation division, Corning Glass Works, Corning, N. Y.

H. S. Phelps (A'21) will represent AIEE on the recently organized American Co-ordinating Committee on Corrosion. He is an engineer in the special investigation and testing division of the Philadelphia Electric Company, Philadelphia, Pa.

H. W. Russell (A'36) chief physicist, Battelle Memorial Institute, Columbus, Ohio, has been appointed to represent that institution on the recently organized American Co-ordinating Committee on Corrosion.

Shoji Seto (A'21) has been elected a vice-president of the Institute of Electrical Engineers of Japan for 1939 and 1940. He is professor of electrical engineering at Tokyo Imperial University, Tokyo, Japan.

W. C. Morrison (Enrolled Student) received the prize for Branch paper awarded by AIEE District Number 5 for his paper on "Synthetic Inductance." He is a student at the University of Iowa, Iowa City.

J. C. Barry, Jr. (A'36) formerly employed in the electric department of the City of Knoxville, Tenn., has been employed by the engineering department of the Illinois Iowa Power Company, at Champaign.

R. E. Blasen (A'34) has become a salesman at Spokane, Wash., for Westinghouse Electric and Manufacturing Company. He was formerly a sales assistant for the company at Seattle, Wash.

J. B. Thomason (A'38) has been employed as an engineer by the Harza Engineering Company, Charleston, S. C. He was formerly data engineer for Emerson Electric Manufacturing Company, St. Louis, Mo.

W. S. Covington (A'38) sales assistant for the Westinghouse Electric and Manufacturing Company, has been transferred from East Pittsburgh, Pa., to Baltimore, Md.

Benjamin Parzen (A'36) has been appointed junior electrical engineer at the Brooklyn Navy Yard, Brooklyn, N. Y. Formerly he was a radio inspector for the Federal Communications Commission.

J. H. Maxim (A'38) student engineer for General Electric Company, has been transferred from Schenectady, N. Y., to Fort Wayne, Ind.

D. C. White (A'32) who has been equipment attendant at Grinnell, Iowa, for the American Telephone and Telegraph Company, has been transferred to Davenport, Iowa.

Obituary

James Delmage Ross (A'08, M'10, F'12) administrator of the Bonneville Dam project, Portland, Ore., and superintendent of the Seattle, Wash., municipal power system, died March 14, 1939, at the Mayo Clinic, Rochester, Minn. Born November 9, 1872, at Chatham, Ont., Canada, and educated there, Mr. Ross began his engineering career as electrical engineer for the City of Seattle. He was in charge of the design, construction, and operation of the city's municipal power plant from its beginning in 1903, becoming in 1911 superintendent of the power system which grew under his management to a $50,000,000 undertaking. He was also a consulting engineer in Seattle, and in 1931 was called in consultation on power problems by the governor of New York State. Since 1933 he had been on leave of absence from the Seattle system, serving as advisory engineer for the United States Public Works Administration, Washington, D. C., until 1935, when he was appointed to the United States Securities and Exchange Commission, Washington, to handle registration of utility holding companies. In 1937 he resigned from the Commission to become administrator of the Bonneville project. He was chairman of the Seattle Section of the AIEE 1912–13.

Austin Burt (A'07, M'08, F'12) city manager and engineer, City of Ontario, Calif., died in September 1938, according to recent information. Born in Detroit, Mich., June 20, 1870, Mr. Burt studied engineering at the Universities of Wisconsin and Minnesota, and at Cornell University from which he received the degree of mechanical engineer in 1900. During the years when he was studying he was employed in engineering positions by Gillette-Herzog, Pillsbury Mills, and Spring Valley Iron Company, all of Minneapolis, Minn., and the Edward P. Allis Company in Milwaukee, Wis. For a quarter of a century he was associated with the development of electric service in Waterloo and Cedar Falls, Iowa, designing and constructing central stations and substations, high-voltage transmission lines, and having charge of operation. Starting as general manager of the Cedar Falls Electric Light Company, which merged with the Waterloo Company, Mr. Burt held engineering and executive positions in the combined companies through various organizational changes, being manager of the Citizens Gas and Electric Company of Waterloo until 1925, when he became vice-president of the Central Iowa Light and Power Company. He had held the position of city manager of Ontario, Calif., for about ten years at the time of his death. Mr. Burt was a member of Sigma Xi, and author of articles on technical subjects.

James Lawrence McQuarrie (A'07, F'26) retired, died at Vineyard Haven, Mass., March 1, 1939. He was born August 15, 1867, at Bath, Maine, where he received a high-school education. In 1882 he was employed as an operator by the New England Telephone and Telegraph Company, Boston, Mass., where he became successively inspector, manager, and engineer. He went with the Western Electric Company in 1894 and served as an engineer in New York and Chicago, becoming assistant chief engineer of the New York division in 1903. He was made assistant chief engineer of International Western Electric Company, New York, N. Y., in 1919 and chief engineer in 1925. In the same year the company became the International Standard Electric Corporation and Mr. McQuarrie was sent as chief engineer to London, England. When that organization was later merged with the International Telephone and Telegraph Company, he returned to New York as vice-president and chief engineer of the latter company, a position which he held until his retirement in 1935.

Clayton Warren Pike (A'91, M'92) consulting electrical engineer, died December 30, 1938, at Southern Pines, N. C. He was born in Fryeburg, Maine, July 11, 1866, and received the degree of bachelor of science in electrical engineering from Massachusetts Institute of Technology in 1889. He was employed as an electrical engineer by the Merrimac Manufacturing Company, Lowell, Mass., for a year, then was an instructor in electrical engineering for two years at the University of Pennsylvania, Philadelphia. He was employed in that city as an electrical engineer by Queen and Company in 1893–94, and by Falkenau Engineering Company from 1894 to 1900. For ten years he was vice-president and general manager of Keller-Pike and Company, Philadelphia. He was chief of the electrical bureau of the City of Philadelphia from 1912 to 1916, and for the remainder of his life a consulting engineer particularly concerned with public utilities. He was the author of books and articles on electrical engineering.

Charles Appleton Terry (A'87, M'87) honorary vice-president, Westinghouse Electric and Manufacturing Company, New York, N. Y., died February 18, 1939. Associated with the Westinghouse Company for half a century as legal counsel, Mr. Terry had handled details of many of the major basic patents of the electrical industry. He was born March 2, 1858, in South Weymouth, Mass., and graduated from Amherst College in 1879 and from Columbia University law school in 1883, specializing in patent law. During his law course he entered the law offices of Franklin L. Pope, patent attorney of New York, and later became a partner in the firm of Pope, Edgecomb, and Terry. In 1888 he joined the Westinghouse company and was head of the patent and legal departments during the struggle to establish the a-c system. Mr. Terry became vice-president of the company in 1909 and held the position until his retirement in 1931. He was a manager of AIEE from 1902 to 1905, and vice-president from 1905 to 1907.

Joseph George Swallow (A'09) retired consulting engineer of the former United Electric Light and Power Company (now Consolidated Edison Company of New York, Inc.), died in Pleasantville, N. Y., January 14, 1939. He was born in Manchester, England, August 25, 1851, and educated there. After coming to the United States he was employed in installation work by the United States Electric Light Company, Newark, N. J., and by the Jeffrey Manufacturing Company, Columbus, Ohio. He was employed by the United Electric Light and Power Company in 1889, and served as superintendent of installation for many years. In 1893 Mr. Swallow went to Chicago, Ill., as assistant engineer for the New York Insulated Wire Company, which wired the grounds of the Columbian Exposition. On his return he resumed his position with the United company. In 1922 he was assigned to the executive department as consulting engineer and continued in this position until his retirement in 1930.

Carl Earnest Hardy (A'99) superintendent, electrical department, City of Oakland, Calif., died February 15, 1939. Mr. Hardy, who was born in Rome, Ga., December 31, 1876, received the degree of bachelor of science in electrical engineering at Virginia Polytechnic Institute in 1897 and later graduated in mechanical engineering at Cornell University. From 1900 to 1911 he was employed as a government naval construction engineer, and for the next four years by Westinghouse Electric and Manufacturing Company in San Francisco, Calif. Appointed in 1915 as superintendent of the Oakland electrical department, he supervised installation of the city's traffic signal lights, police and fire signals, and street lighting system.

Henry Herrman (A'15) manager, thermometals department, The H. A. Wilson Company, Newark, N. J., died October 17, 1938, according to information just received at Institute headquarters. Mr. Herrman was born April 30, 1864, at Hamburg, Germany, where he attended school and college. Prior to his association with the H. A. Wilson Company, he was manager of the metals department at the Fort Wayne, Ind., works of the General Electric Company.

Frederick M. Wilbraham (A'19) consulting engineer for the Hartford Electric Light Company, Hartford, Conn., died January 21, 1939. Mr. Wilbraham was born in Hartford November 19, 1862, and entered the employ of the Hartford Electric Light Company as a switchboard operator in 1891, advancing by successive stages to the position of superintendent of power. For more than 15 years he had been a consulting engineer for the company.

Oliver J. Morgan (A'36) electrical inspector for the Delaware, Lackawanna, and Western Railroad Company, East Stroudsburg, Pa. died recently. Born November 18, 1892, at Madison, N. J., Mr. Morgan was associated with the Lackawanna road during most of his life.

Membership

Recommended for Transfer

The board of examiners, at its meeting on March 16, 1939, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Fellow

Holmes, H. A., planning engineer, Monongahela West Penn Public Service Company, Fairmont, W. Va.
Lovell, A. H., professor of electrical engineering and assistant dean and secretary, College of Engineering, University of Michigan, Ann Arbor.
Morgan, T. H., head, electrical engineering department, Worcester Polytechnic Institute, Worcester, Mass.

3 to Grade of Fellow

To Grade of Member

Dunlap, R. L., assistant engineer, Bell Telephone Company of Pennsylvania, Pittsburgh.
Evans, O. D., electrical engineer, Oklahoma Gas and Electric Company, Oklahoma City.
Gove, H. E., electrical engineer, Union Electric Company of Missouri, St. Louis.
Horton, H. M., district engineer, Oklahoma Gas and Electric Company, Oklahoma City.
Kinzly, N. T., superintendent of distribution, Tennessee Electric Power Company, Nashville.
Knaf, H. G., division engineer, Consolidated Edison Company of New York, Inc., New York.

Kulman, F. E., junior engineer, Consolidated Edison Company of New York, Inc., New York.
Laughlin, C. W., division transmission engineer, American Telephone and Telegraph Company, St. Louis, Mo.
Metcalfe, Donald, staff assistant, American Telephone and Telegraph Company, New York, N. Y.
Morgan, F. I., maintenance assistant, Pennsylvania Water and Power Company, Baltimore, Md.
Penney, G. W., manager, electro-physics division, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Southgate, G. T., consulting engineer, New York, N. Y.
Thomas, M. A., professor of electrical engineering, New Mexico State College, State College.
Torgersen, Harold, instructor, New York University, New York, N. Y.

14 to Grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. If the applicant has applied for direct admission to a grade higher than Associate, the grade follows immediately after the name. Any member objecting to the election of any of these candidates should so inform the national secretary before April 30, 1939, or June 30, 1939, if the applicant resides outside of the United States or Canada:

United States and Canada

Adamson, E. W., 622 Bellaire Avenue, Pittsburgh, Pa.
Agin, J., care of A. Koenigsberg Company, New York, N. Y.
Alexander, R. G., General Radio Company, Cambridge, Mass.
Altschule, H., Jewel Incandescent Lamp Company, Newark, N. J.
Alworth, R. E., Public Utilities Commission, Boise, Idaho.
Ammann, W., Consolidated Edison Company of New York, Inc., New York, N. Y.
Anderson, E. L., Electro-Motive Corporation, La Grange, Ill.
Anderson, J. F., United States Bureau of Reclamation, Cody, Wyo.
Anema, G., Michigan State Highway Department, Lansing, Mich.
Aulick, B. W., Halliburton Oil Well Cementing Company, Houma, La.
Backus, W. A., Signal Corps Reserve, United States Army, Fort Monmouth, Oceanport, N. J.
Baily, A. L., West Penn Power Company, Washington, Pa.
Banta, F. D., International Business Machine Corporation, Endicott, N. Y.
Barcus, G. L., United States Bureau of Reclamation, Denver, Colo.
Barnes, W. J. (Member), Walter J. Barnes Electric Company, New Orleans, La.
Barrett, E. J., Sierra Pacific Power Company, Reno, Nev.
Barrows, M. D., Indiana and Michigan Electric Company, South Bend, Ind.
Bauer, J. L., United States Bureau of Reclamation, Denver, Colo.
Bean, C. L., United States Army, Vancouver, Wash.
Beard, C. I., Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.
Beckwith, E. F., 2011 West Erie Avenue, Lorain, Ohio.
Bedell, L., Bridgeman Electric Company, and Bridgeman General Contractor, Albuquerque, N. Mex.
Benham, T. A., Haverford College, Haverford, Pa.
Besier, A. P., Bell Telephone Laboratories, New York, N. Y.
Bilton, D. E., Bell Telephone Laboratories, New York, N. Y.
Bissey, L. J., 676 West Third Street, Loveland, Colo.
Bitonti, J. L., Ohio State University, Columbus.
Boggs, A. C., E. L. Wiegand Company, Pittsburgh, Pa.
Bowen, E. W., Pet Milk Company, Hudson, Mich.
Bradley, S. L., Halliburton Oil Well Cementing Company, Duncan, Okla.
Bradshaw, E. F., Murray Corporation of America, Detroit, Mich.
Brainerd, J. G. (Member), University of Pennsylvania, Philadelphia, Pa.
Brancato, E. L., United States Navy, Boston, Mass.
Brandt, P., Jr., Byron Weston Company, Dalton, Mass.
Braun, O. J., Amalgamated Electric Corporation, Ltd., Toronto, Ont., Canada.
Brettman, H., Rural Electrification Administration, Washington, D. C.
Bretz, G. W., Jr., 824 Highland Avenue, Bethlehem, Pa.
Brown, H. L., El Paso Electric Company, El Paso, Tex.
Brown, R. W., 1808 West Fifth Street, Sioux City, Iowa.
Browning, R. L., Jr., Black and Veatch, Kansas City, Mo.
Bruere, W. B. (Member), Portland General Electric Company, Portland, Ore.
Buehler, E. F., R. A. Donahue, Macomb, Ill.
Bullock, W. E., H. C. MacNary, New York, N. Y.
Bumpas, W. E., United States Bureau of Reclamation, Pavillion, Wyo.
Burkhart, J. R., General Electric Company, Schenectady, N. Y.
Busch, P. R., Rural Electrification Administration Lines, Winterset, Iowa.
Bush, R. L., Cannon Electric Development Company, Los Angeles, Calif.
Butler, N. O., Oklahoma University, Oklahoma City.
Campbell, J. A., care of James G. Cooney, Belleville, Ill.
Carroll, W. E., Illinois Bell Telephone Company, Lake Forest.
Caruthers, F. P., Jr., Phoenix Engineering Corporation, Houston, Tex.
Chapman, C. W., 810 South Philadelphia Street, Anaheim, Calif.
Ciesielski, J., Walter Scholer, Lafayette, Ind.
Clark, D. S., New York Telephone Company, New York, N. Y.
Claussen, F. B., Claussen and Claussen, Portland, Ore.
Clem, C. K., Control House, Chickamauga Dam, Chattanooga, Tenn.
Cloud, R. W., Massachusetts Institute of Technology, Cambridge, Mass.
Cochran, K. W., Iowa State College, Ames.
Coleman, A., United States Signal Corps, Oceanport, N. J.
Colin, R. J., Jr., Gooder-Henrichsen Company, Inc., Chicago, Ill.
Colvin, L. D., Pacific Gas and Electric Company, San Francisco, Calif.
Cooney, J. A., Hartford Electric Light Company, Hartford, Conn.
Cooper, J. E., 28 East Seventy-fourth Street, New York, N. Y.
Cooper, L. E., Railroad Commission of California, San Francisco.
Coronella, F. S., 103 Chambers Street, Boston, Mass.
Courtin, J. J., F. W. Woolworth Company, Germantown, Pa.
Cozine, H. E., 369 Third Street, Brooklyn, N. Y.
Crawford, C. S., Diboll, Kessels and Associates, New Orleans, La.
Cross, L. H., North Road, Lancaster, N. H.
Crouch, C. A., Atchison, Topeka and Santa Fe Railway Company, Topeka, Kans.
Cully, J. F., Indiana and Michigan Electric Company, South Bend, Ind.
Curry, N., United States Motors, Inc., Los Angeles, Calif.
Curtiss, W. L., 2118 Ashland Avenue, St. Joseph, Mo.
Cushing, W. R., 432 East Court Street, Gainesville, Fla.
Dana, H. D., Electro-Motive Corporation, La Grange, Ill.
Darby, L. E., Indiana and Michigan Electric Company, South Bend, Ind.
Daubenheyer, H. W., Oklahoma Gas and Electric Company, Oklahoma City.
Davidson, E. R., Pacific Gas and Electric Company, San Francisco, Calif.
Davis, B., 682 Twenty-eighth Street, Oakland, Calif.
Davis, J. W., Piedmont and Northern Railroad Company, Greenville, S. C.
Day, R. P., Factory Insurance Association, Hartford, Conn.
Decker, F. A. (Member), College of Mines and Metallurgy, El Paso, Tex.
De Majo, J. J. R., Larmloc Corporation, New Orleans, La.
DeMar, J. J., 2053 Grace Street, Chicago, Ill.
Dempsey, J. J., Jr., 724 North Yakima Avenue, Takoma, Wash.
DeWild, J. A., K. R. Brown, Des Moines, Iowa.
D'Hippolito, M. J., United States Army, Fort Dupont, Del.
Dittmann, W. L., University of Wisconsin, Madison.
Dod, A. B., Jr., Phelps Dodge Copper Products Corporation, Yonkers, N. Y.
Dole, A. R., Western Electric Company, Portland, Ore.
Donnelly, J. W., Consolidated Gas Electric Light and Power Company of Baltimore, Md.
Downing, C. R., Public Service Company of Oklahoma, Tulsa.
Draper, J. K., General Delivery, Casa Grande, Ariz.
Dravneek, W. R., Signal Engineering and Manufacturing Company, New York, N. Y.
Dunkelman, L., Portsmouth Navy Yard, Portsmouth, N. H.
Dunning, K. L., Western Union Telegraph Company, New York, N. Y.
Durkin, W. T., 318 West Henley Street, Olean, N. Y.
Eddy, M. H., Lincoln Electric Company, Cleveland, Ohio.
Edwards, E. A., Taylor Instrument Companies, Rochester, N. Y.
Efthim, C., 1016 Louisville Avenue, St. Louis, Mo.
Eiwen, C. J., Westinghouse Electric Elevator Company, Jersey City, N. J.
Ellis, W. C., New Orleans Public Service, Inc., New Orleans, La.
Emanuel, N., Pittsburgh Board of Public Education, Pittsburgh, Pa.
Emmer, A., Amperex Electronics Products, Brooklyn, N. Y.
Empey, R. W., State Geodetic Survey, Des Moines, Iowa.
Engel, F. A., Jr., 120 Cove Road, Hollidays Cove, W. Va.
Esselman, W. H., National Union Radio Corporation, Newark, N. J.
Evans, B., General Electric Company, Schenectady, N. Y.
Evans, D. J., 512 N. Jackson St., Hutchinson, Kans.
Feist, D. N., Warner Elevator Manufacturing Company, Cincinnati, Ohio.
Fisher, F. E., Appalachian Electric Power Company, Montgomery, W. Va.
Fleckenstein, E. L., Electrical Vocational High, Cincinnati, Ohio.
Flora, W. W., 900 W. 31st Street, Cheyenne, Wyo.
Ford, M. A., Indiana and Michigan Electric Company, Benton Harbor, Mich.
Foskett, D. B., Spreckels Sugar Company, Spreckels, Calif.
Frazier, J. F., Clarkson College of Technology, Potsdam, N. Y.
Friedman, T. B., Ward Products Corporation, Cleveland, Ohio.
Fullwood, H. S., United States Bureau of Reclamation, Wauwatosa, Wis.
Fulton, D. C., Jr., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Gaillard, R. L., 331 East Fourteenth Street, New York, N. Y.
Gaskin, G. C., Jr., University of South Carolina, Columbia.
Gates, C. F., General Petroleum Corporation of California, Bakersfield.
Gebel, I., International Register Company, Chicago, Ill.
Gerrish, D. I., Department of Public Works, New York, N. Y.
Gibson, J. E., Indiana and Michigan Electric Company, South Bend, Ind.
Giezentanner, R. B., Commonwealth Edison Company, Chicago, Ill.
Gilinson, P. J., Jr., Pacific Mills, Lawrence, Mass.
Gill, G. H., San Diego Engineering Laboratories, San Diego, Calif.
Gillette, L. H., Idaho County Light and Power Co-operative Association, Inc., Grangeville.
Gilliam, M. H., E. H. Gilliam Company, Charlotte, N. C.
Gise, L., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Goetz, G. A., Bethlehem Steel Company, Bethlehem, Pa.
Goff, P. C., Board of Fire Underwriters, Los Angeles, Calif.
Gottron, G. L., Bell Telephone Laboratories, Inc., New York, N. Y.
Graham, A. H., General Electric Company, Erie, Pa.
Gray, R. I., Nashua Manufacturing Company, Nashua, N. H.
Green, A. B., Duquesne Light Company, Pittsburgh, Pa.
Gregory, J. F., Springfield, Ky.
Griemsmann, J. W. E., Polytechnic Institute of Brooklyn, Brooklyn, N. Y.
Griffiths, R. W., Bonneville Project, Hood River, Oregon.
Grimaldi, P. J., 1170 Gates Avenue, Brooklyn, N. Y.
Guglielmo, G. E., Paulina, La.
Hahn, E. R., Continental Can Company, New York, N. Y.
Haight, D. M., Route 6, Paola, Kans.
Haire, A. E., Tacoma Light Department, Tacoma, Wash.
Hale, N. H., Caterpillar Tractor Company, Peoria, Ill.
Halme, T. J., Canadian General Electric Company, Peterborough, Ont., Canada.
Hamburger, G., III (Member), Kennecott Wire and Cable Company, Chicago, Ill.
Hammond, J. W., Briggs Pump and Supply Company, West Lafayette, Ind.
Hanson, L. K., Electric Machinery Manufacturing Company, Minneapolis, Minn.
Hareid, D. T., Bell Telephone Laboratories, New York, N. Y.
Harris, B. G., Reliable Electric Company, Chicago, Illinois.
Harrold, W. T., KVI Puget Sound Broadcasting Company, Seattle, Wash.
Harter, V. J., New Jersey Bell Telephone Company, Newark.
Haverstick, J. S., DeLaval Steam Turbine Company, Trenton, N. J.
Hendry, A. J., Works Progress Administration, Detroit Lakes, Minnesota.
Herchenroeder, L. W., Iowa State College, Ames.
Hildebrand, R. L., Westinghouse Electric and Manufacturing Company, Cleveland, Ohio.
Hill, R. C., Indiana and Michigan Electric Company, South Bend, Ind.
Hill, W. A. (Member), Toledo Edison Company, Toledo, Ohio.
Hilliard, M. C., Southern California Edison Company, Ltd., Los Angeles.
Hino, K., 5646 Harper Avenue, Chicago, Ill.
Holt, C. O., Alvarado Telephone Company, Alvarado, Minn.
Horman, A. S., 118 Collins Avenue, Baltimore, Md.
Holmlin, H. W., Bell Telephone Laboratories, New York, N. Y.

Hornung, H. G., Ohio Power Company, Lima.
Hsu, C. P., California Institute of Technology, Pasadena.
Hudson, P. K., 31 Second Street, Athens, Ohio.
Huffman, M. M., Northern Indiana Public Service Company, Kentland.
Hughes, J. G., Duquesne Light Company, Pittsburgh, Pa.
Hulley, J. R., Gibbs & Hill, Inc., Parkers Landing, Pa.
Hunter, R. N., Bell Telephone Laboratories, New York, N. Y.
Ilgenfritz, L. M. (Member), Bell Telephone Laboratories, Inc., New York, N. Y.
Ipsen, S. J., 3749 Richmond Road, Richmond, Staten Island, N. Y.
Jenkins, R. J., Halliburton Oil Well Cementing Company, Mission, Tex.
Jepson, J. A., Central New York Power Corporation, Potsdam, N. Y.
Johnson, R. F., Black and Veatch, Kansas City, Mo.
Johnston, C. C., Mississippi State College, State College.
Johnstone, R. B., Electro-Motive Corporation, La Grange, Ill.
Jones, E. W., Cornell University, Ithaca, N. Y.
Jordan, B. B., Picker X-Ray Corporation, New York, N. Y.
Kauppi, K. O., Carnegie-Illinois Steel Corporation, Chicago, Ill.
Keithley, K. E., Texas-Empire Pipe Line, Tulsa, Okla.
Kelsey, S. G., Gausman and Moore, St. Paul, Minn.
Kessler, E. H., East Northport, N. Y.
Kiekhaefer, E. C. (Member), Kiekhaefer Corporation, Cedarburg, Wis.
Kinnebrew, W. E., Public Service Company of Oklahoma, Weleetka.
Kitzerow, D. J., Pressed Steel Tank Company, Milwaukee, Wis.
Klemesrud, H. L., 237 Sheldon Avenue, Ames, Iowa.
Korsan, W. E., The Louis Allis Company, Milwaukee, Wis.
Kosara, P. A., Jr., 164-27 Grand Central Parkway, Jamaica, N. Y.
Kurriss, F. J., New York Telephone Company, New York, N. Y.
Lacock, D. P., Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.
Lake, C. J., National Union Radio Corporation, Newark, N. J.
Larsen, C. (Member), Light and Water Department, Lakeland, Fla.
Larson, L. A., Puget Sound Power and Light Company, Seattle, Wash.
Latzko, F. R. (Member), 558 West 189th Street, New York, N. Y.
Lees, A. R., Oliver Institute, Edmonton, Canada.
Leslie, M. W., University of Minnesota, Minneapolis.
Liberatore, D., New York City Department of Water Supply, Gas and Electricity, New York, N. Y.
Lindstrom, G. G., Electric Storage Battery Company, Philadelphia, Pa.
Linkletter, R. L., Puget Sound Navy Yard, Bremerton, Wash.
Lintern, A. J., Cleveland Electric Illuminating Company, Cleveland, Ohio.
Littlefield, H. Y., 311 South Craig Street, Pittsburgh, Pa.
Love, R. M., Durham Public Service Company, Durham, N. C.
Lovelace, B. A., 248 Worcester Road, Framingham, Mass.
Long, V. O., University of Colorado, Boulder.
Lundgren, C. W., Central Illinois Public Service Company, Mattoon.
Lutz, P. C., United States Navy, Washington, D. C.
Lynch, H. P., Bell Telephone Laboratories, Inc., New York, N. Y.
Mallach, L. W., Northwestern Electric Company, Portland, Ore.
Mann, P., Pacific Power and Light Company, Milton, Ore.
Mannal, C., General Electric Company, Pittsfield, Mass.
Manzavinos, A. T., 523 West 135th Street, New York, N. Y.
Markel, N. W., New Orleans Public Service, New Orleans, La.
Mattingly, R. L., Day and Zimmerman, Indiana, Pa.
McCabe, B. J., Poucher, Wood and Wallin, Inc., Poughkeepsie, N. Y.
McDonald, A. A., 1630 North Main Street, Los Angeles, Calif.
McElroy, W. C., Post Office Box 609, Greeley, Colo.
McMahan, W., Tennessee Valley Authority, Pickwick Dam, Tenn.
McMahon, E. V., J. B. McCrary Engineering Corporation, Atlanta, Ga.
McRoberts, C. E., Amalgamated Electric Corporation, Ltd., Toronto, Ont., Canada.
Menes, F. A., Jr., New York Telephone Company, New York, N. Y.
Merrell, C. M., City of Glendale, Calif.
Meyerhoff, L. (Member), General Cable Corporation, Perth Amboy, N. J.
Miller, J. B., Bucknell University, Lewisburg, Pa.
Miller, L. N., San Diego Consolidated Gas and Electric Company, San Diego, Calif.
Mirkin, M., Indiana and Michigan Electric Company, South Bend, Ind.
Moberg, C. V., Consolidated Gas, Electric Light and Power Company of Baltimore, Md.
Molinski, A. E., Bethlehem Steel Corporation, Johnstown, Pa.
Mohr, M. E., Bell Telephone Laboratories, Inc., New York, N. Y.
Moran, J. P., Consolidated Edison Company of New York, Inc., New York, N. Y.
Morgan, M. I., Tennessee Valley Authority, Knoxville, Tenn.
Morris, R. J., Bell Telephone Laboratories, Inc., New York, N. Y.
Morrow, G., Keystone Oil Burner Corporation, Brooklyn, N. Y.
Myers, J. S., General Electric Company, Schenectady, N. Y.
Nankervis, B. J., International Business Machines Corporation, Houston, Tex.
Nettles, J. C., Hinckley's Electric Service, Monroe, La.
Neumann, A. J., 500 Riverside Drive, New York, N. Y.
Nevin, W. C., B-A-R-C Electric Co-operative, Millboro, Va.
Newberry, R. C., Otis Elevator Company, Springfield, Ohio.
Norman, F. F., Pacific Gas and Electric Company, San Francisco, Calif.
Nunan, J. K., University of Southern California, Los Angeles.
O'Connell, A. W., Ginn Electric Company, Cincinnati, Ohio.
Odenthal, L. P., 215 North St. Andrews Place, Los Angeles, Calif.
O'Donnell, A. J., Jr., Westinghouse X-Ray Company, Long Island City, N. Y.
Ottinger, C. F., United States Army, Coast Artillery Reserve, Fort Winfield Scott, Calif.
Parish, C. L., Monsanto Chemical Company, Columbia, Tenn.
Parsons, S., Consolidated Edison Company of New York, Inc., New York.
Patrick, R., Washington Water Power Company, Lewiston, Idaho.
Patterson, J. H., Ohio Power Company, Canton.
Perkins, S. F., Jr., New England Power Service Company, Worcester, Mass.
Perry, R. E., Route 2, Box 33 A, Manteca, Calif.
Phillips, C. V., 317 North Third Street, Marion, Kans.
Phillips, G. M., Bell Telephone Laboratories, Inc., New York, N. Y.
Phillips, R. E., Kansas Gas and Electric Company, Wichita.
Phillips, W. R., Jr., Route No. 3, Raleigh, N. C.
Phinney, J. H., United States Department of Commerce, Washington, D. C.
Pilcher, M. A., Kentucky and West Virginia Power Company, Inc., Ashland, Ky.
Poekel, C. A., Curtiss Propeller Division, Clifton, N. J.
Post, C. R., Western Electric Company, Inc., Washington, D. C.
Prather, T. C., Tennessee Valley Authority, Knoxville, Tenn.
Prichard, J. S., Western Pipe and Steel Company, Grand Coulee, Wash.
Pugh, H. F., Texas Company, Denver, Colo.
Quadrine, A. G., Lionel Corporation, Irvington, N. J.
Quayle, V. H., Quam-Nichols Company, Chicago, Ill.
Radcliffe, J. H., General Electric Company, Toronto, Ont., Canada.
Radmacher, D. S., Crown Willamette Paper Company, Camas, Wash.
Reinhardt, K. W., Socony Vacuum Oil Company, Inc., Olean, N. Y.
Ressa, J., Cambridge Instrument Company, Ossining, N. Y.
Reynolds, O. K., Jr., 624 East 220th Street, New York, N. Y.
Rhodes, C. F., Revere Copper and Brass Company, Rome, N. Y.
Rice, A. J., Material Laboratory, Navy Yard, New York, N. Y.
Richardson, R. D., Westinghouse Electric and Manufacturing Company, Belleville, N. J.
Rifkin, S., United States Bureau of Reclamation, Denver, Colo.
Roadcap, G. D., Missouri Valley Electric Company, Kansas City, Mo.
Roberts, F. C., General Electric Company, New York, N. Y.
Roberts, H. C., New York Shipbuilding Corporation, Camden, N. J.
Roberts, H. P., care of James G. Cooney, Belleville, Ill.
Robinson, J. M., North Electric Manufacturing Company, Galion, Ohio.
Rodgers, J. M., Delco Products Corporation, Dayton, Ohio.
Rombach, J. R., Jr., New Orleans Public Service, Inc., New Orleans, La.
Ross, A. K., Western Union Telegraph Company, San Francisco, Calif.
Rugg, P. J., Tennessee Valley Authority, Knoxville, Tenn.
Ruocco, W. P., Jr. (Member), General Electric Company, New York, N. Y.
Rushforth, G., Pacific Gas and Electric Company, San Francisco, Calif.
Rzeppa, T. S., Karnes City, Tex.
Sahlman, F. M., 417 Twelfth Street, Cloquet, Minn.
Salvadge, C. H., Canadian General Electric Company, Peterborough, Ont.
Sayford, F. M., Jr., Frank M. Sayford Company, Brooklyn, N. Y.
Sayko, C. J., Standard Oil Company of New Jersey, Elizabeth.
Schaller, F. D., Picker X-Ray Corporation, Boston, Mass.
Scarborough, F. L., Tennessee Valley Authority, Chattanooga, Tenn.
Scheer, E. W., Jr., Bell Telephone Company of Pennsylvania, Philadelphia.
Scherf, P. H., Indiana Steel Products Company, Valparaiso.
Scherrer, G. M., A. Y. Taylor and Company, Clayton, Mo.
Schreiber, I. R., Virginia Public Service Company, Clifton Forge.
Schultheiss, C. E., University of Wisconsin, Madison.
Schultz, B. F., University of Oklahoma, Norman.
Scifres, R. E., Purdue University, West Lafayette, Ind.
Scott, E. E., Shell Petroleum Corporation, Shelbyville, Ill.
Seabury, R. L., General Motors Corporation, Muncie, Ind.
Seidman, G., 1519 Bouton Road, Troy, N. Y.
Shaffer, W. B., Power Equipment Company, Detroit, Mich.
Shannon, C. E., Massachusetts Institute of Technology, Cambridge.
Shellenberger, E. J., Halliburton Oil Well Cementing Company, Duncan, Okla.
Shelling, L., Boeing Aircraft of Canada, Vancouver, B. C.
Sherman, W. A., Narragansett Electric Company, Providence, R. I.
Shick, D. H., Illinois-Iowa Power Company, Bloomington, Ill.
Simpson, T. J., Engineering Research Corporation, Shreveport, La.
Sindeband, S. J., Consolidated Edison Company of New York, Inc., New York, N. Y.
Skootsky, H., State Relief Administration, San Francisco, Calif.
Slate, E. V., Department of Finance, Budget and Business, Olympia, Wash.
Smith, C. E., Indiana and Michigan Electric Company, South Bend, Ind.
Smith, C. R., General Electric Company, Schenectady, N. Y.
Smith, W. B., Bangor Evening School, Brewer, Maine.
Spielman, W. L., Baumes Engineering Company, St. Louis, Mo.
Sprague, W. R., University of Pittsburgh, Pittsburgh, Pa.
Stanhope, H. W. P. (Member), American Gas and Electric Service Corporation, New York, N. Y.
Steinhilber, T. H., Monsanto Chemical Company, Columbia, Tenn.
Stirling, H. H. (Member), Federal Power Commission, Atlanta, Ga.
Strohman, J. Y., 1901 Fairview Avenue, Easton, Pa.
Sturdevant, E. G. (Member), United States Rubber Company, Bristol, R. I.
Summers, F. R., Black and Veatch, Kansas City, Mo.
Sylvan, A. W., American Telephone and Telegraph Company, New York, N. Y.
Tallman, S. C., Bell Telephone Laboratories, New York, N. Y.
Taylor, G. E., Oklahoma Gas and Electric Company, Ardmore.
Tepper, C., United States Army, Fort Monmouth, N. J.
Theis, H. T., Day and Zimmerman, Inc., Philadelphia, Pa.
Thompson, B. V., International Telephone Development Company, Inc., Newark, N. J.
Thompson, W. L., Amber Electric Supply Company, Chicago, Ill.
Thumm, J. R., Lincoln Electric Company, Cleveland, Ohio.
Timbie, T. R., General Electric Company, Lynn, Mass.
Tolles, R. W., Stanley Works, New Britain, Conn.
Torian, J. T., R.C.A. Radiotron, Harrison, N. J.
Trim, Laurence O., City of Burbank, Calif.
Troxel, S. H., Jr., Philadelphia Electric Company, Philadelphia, Pa.
Troy, M. O., Jr., General Electric Company, Schenectady, N. Y.
Trubey, H. E., Jr., Trubey's Drug Store, Ellsworth, Kans.
Tuttle, A. D., New York State Electric and Gas Corporation, Hornell.
Uster, R. J., Jr., New York Telephone Company, Brooklyn.
Waligoski, A. A. (Member), Southern New England Telephone Company, New Haven, Conn.
Wallace, R. J., General Electric Company, Erie, Pa.
Ward, L. M., Southwestern Bell Telephone Company, Great Bend, Kans.
Ward, P. L., General Electric Company, San Francisco, Calif.
Waugh, D. L., 333 Crosby Street, Akron, Ohio.
Weathers, W. B., Westinghouse Electric Supply Company, Columbia, S. C.
Weber, P. J., Cooper Union Institute, New York, N. Y.
Webster, H. L., Fair Price Oil Company, Woonsocket, S. Dak.
Welker, J. W., Philadelphia Electric Company, Philadelphia, Pa.
Welty, R., Rural Electrification Administration, Washington, D. C.
Whaling, R. M., 835 Loring Avenue, Crockett, Calif.
White, J. A., Transmitter Equipment Manufacturing Company, Inc., New York, N. Y.

Whitman, L. C., General Electric Company, Pittsfield, Mass.
Wider, F. E., Board of State Harbor Commissioners, San Francisco, Calif.
Williams, E. A., Jr., Sperry Gyroscope Company, San Francisco, Calif.
Williams, N., 1144 Calumet Avenue, Calumet, Mich.
Wilson, H. R., Philadelphia Electric Company, Philadelphia, Pa.
Wilson, W. R., Elko Lamoille Power Company, Elko, Nevada.
Winn, V. C., Central Hudson Gas and Electric Corporation, Kingston, N. Y.
Wolf, E. F., Consolidated Gas, Electric Light and Power Company of Baltimore, Md.
Wood, H. B., 54 Le Moyne Avenue, Mount Lebanon, Pittsburgh, Pa.
Worona, N., Fort Hamilton, Brooklyn, N. Y.
Worthen, G. B., 385 Elm Street, Montpelier, Vt.
Worthen, P. W., General Electric Company, Schenectady, N. Y.
Woy, J. H., care of J. S. Hartt, Madison, Wis.
Wright, J. A., Puget Sound Power and Light Company, Seattle, Wash.
Wright, P. B., American Telephone and Telegraph Company, Phoenix, Ariz.
Wulfert, K. J., St. Louis County Health Department, Clayton, Mo.
Wynne, J. F., Western Union Telegraph Company, Denver, Colo.
Yadofsky, Z., 1710 Carroll Street, Brooklyn, N. Y.
Yokich, M., Box 14, Kinney, Minn.
Zimmerman, E. E., Chrysler Corporation, Detroit, Mich.
Zollinger, C., Indiana Bell Telephone Company, Indianapolis.

Total, United States and Canada—374

Elsewhere

Cadilla, J. A., Puerto Rico Distilling Company, Arecibo.
Correro, C. A., Cia Sole, Inc., San Juan, Puerto Rico.
di Lauro, J. J., Estudios San Miguel, Buenos Aires, Argentina.
Fernando, W. W. L., Messrs. English Electric Company, Ltd., Stafford, England.
Froome, W. J., Hawaiian Electric Company, Honolulu.
Lawyer, M. K., Water Works Department, Bombay Municipality, India.
Modi, J. T., Surat Electricity Company, Ltd., Surat, India.
Natarajan, K., Crompton Engineering Company, Ltd., Madras, South India.
Paton, J. E., Sydney County Council, Sydney, N. S. W., Australia.
Ringer, F. W., Lago Oil and Transport Company, Ltd., Aruba, Curacao, Netherlands West Indies.
Safra, J., Chark Apartment, Taksim, Istanbul, Turkey.
Seifert, C. G., Jr., Apartado 81-Bix, Mexico, D. F., Mexico.
Sims, K. E., Borough of Finchley Electricity Undertaking, London, N. 3, England.
Vanvales, D. M., Hawaiian Electric Company, Honolulu.

Total, elsewhere—14

Engineering Literature

New Books in the Societies Library

Among the new books received at the Engineering Societies Library, New York, N. Y., recently are the following which have been selected because of their possible interest to the electrical engineer. Unless otherwise specified, books listed have been presented gratis by the publishers. The Institute assumes no responsibility for statements made in the following outlines, information for which is taken from the preface of the book in question.

THE REFRIGERATING DATA BOOK, Volume 1. Refrigerating Principles and Machinery. Fourth edition. New York, American Society of Refrigerating Engineers, 1939. 527 pages. (Refrigerating Catalog and List of A.S.R.E. Members Section, 134 pages), illustrated, 10 by 6 inches, cloth, \$4.00 in U. S. A., \$4.50 in foreign countries. Brings together essential information and numerical data on refrigeration and air conditioning. An appendix gives a directory of equipment manufacturers and distributors, and a list of members of the society.

THE PERFORMANCE AND DESIGN OF DIRECT CURRENT MACHINES. (Engineering Degree Series.) By A. E. Clayton. Second edition. London, Sir Isaac Pitman & Sons; New York, Pitman Publishing Corporation, 1938. 445 pages, illustrated, 9 by 6 inches, cloth, \$5.00. Explains the fundamental principles, load characteristics, control methods, efficiency, and testing of d-c machines. The mechanical construction and details are described with the aid of numerous illustrations, and detailed design information is given for various representative types of machines. A set of numerical examples for solution is included.

THE PERCEPTION OF LIGHT. By W. D. Wright. New York, Chemical Publishing Company, 1939. 100 pages, charts, etc., 8 by 5 inches, cloth, \$2.50. A concise analysis of the visual phenomena of most importance to lighting engineers and others concerned with lighting problems. Special attention is paid to purely physiological investigations in this field. Among the topics considered are vision at low and high intensities, glare, and visual sensations.

PHYSIK. By P. Wessel and V. R. von Paar. Munich, Ernst Reinhardt, 1938. 514 pages, charts, etc., 8 by 5 inches, leather, 4.90 rm. This college textbook covers the customary topics included in physics courses.

Die ORTSFESTEN ANLAGEN ELEKTRISCHER BAHNEN. By K. Sachs. Zurich and Leipzig, Orell Füssli Verlag, 1938. 321 pages, illustrated, 11 by 8 inches, cloth, 29 rm., 48 Swiss frs. The construction of electric railways is presented with unusual detail in this treatise, which is based upon current practice throughout the world.

APPLIED GEOPHYSICS in the Search for Minerals. By A. S. Eve and D. A. Keys. Third edition. Cambridge, England, University Press; New York, Macmillan Company, 1938. 316 pages, illustrated, 9 by 6 inches, cloth, \$4.25. The various exploratory methods now available: magnetic, electrical, electromagnetic, gravitational, seismic, radioactive, etc., are discussed theoretically and practically.

(The) ELECTROCHEMISTRY of GASES and OTHER DIELECTRICS. By G. Glockler and S. C. Lind. New York, John Wiley & Sons, 1939. 469 pages, illustrated, 9 by 6 inches, cloth, \$6.00. This monograph, which was undertaken at the request of the Committee of Electrical Insulation of the National Research Council, brings together material on the behavior of liquids and gases in the electric field. Part one discusses the physical aspects of various kinds of discharge. Part two describes the reactions that have been studied. Part three discusses the underlying theory.

(The) ENGINEERS' MANUAL. By R. G. Hudson. Second edition. New York, John Wiley & Sons, 1939. 340 pages, illustrated, 8 by 5 inches, leather, \$2.75. A collection of engineering formulas, mathematical operations, and tables that are constantly wanted by engineers and students of engineering.

FRACTIONAL HORSEPOWER ELECTRIC MOTORS. By C. G. Veinott. New York and London, McGraw-Hill Book Company, 1939. 431 pages, illustrated, 9 by 6 inches, cloth, \$3.50. A treatment on fractional-horsepower motors; 18 major types are described, the descriptions explaining their principles of operation, usual forms of construction, speed-torque characteristics, methods of connection, repairing, rewinding, testing, etc.

GMELINS HANDBUCH der ANORGANISCHEN CHEMIE. Eighth revised edition. Edited by Deutsche Chemische Gesellschaft. EISEN, Teil D. 1. Ergänzungsband. MAGNETISCHE und ELEKTRISCHE EIGENSCHAFTEN des EISENS und SEINER LEGIERUNGEN. System-Nummer 59. Berlin, Verlag-Chemie, 1937. 148 pages, illustrated, 10 by 7 inches, paper, 18 rm. New information is presented upon the electric and magnetic properties of iron and its alloys, especially the alloy steels.

KEMPE'S ENGINEER'S YEAR-BOOK 1939. 45th annual issue. Revised under the direction of L. St.L. Pendred. London, Morgan Bros., 1939. 2,824 pages, illustrated, 7 by 5 inches, leather, 31s. 6d. An annual British publication covering modern practice in civil, mechanical, electrical, marine, gas, aero, mine, and metallurgical engineering.

SPONTANEOUS FLUCTUATIONS of VOLTAGE, Due to Brownien Motions of Electricity, Shot Effect, and Kindred Phenomena. By E. B. Moullin. Oxford, England, Clarendon Press; New York, Oxford University Press, 1938. 251 pages, illustrated, 10 by 6 inches, cloth, \$6.00. A study of fluctuations in electric circuits caused by thermal agitations of free electrons in conductors or by their random emission from hot surfaces. Based upon personal experimental work, this book summarizes present knowledge concerning these phenomena.

THEORY and APPLICATIONS of ELECTRON TUBES. By H. J. Reich. New York and London, McGraw-Hill Book Co., 1939. 670 pages, illustrated, 9 by 6 inches, cloth, \$5.00. This book in intended to give the student, in one volume, a sufficiently thorough grounding in the fundamental principles of electron tubes and associated circuits to enable him to apply electron tubes to the solution of new problems.

RAILWAYS TO-DAY. (The Pageant of Progress.) By J. W. Williamson. London and New York, Oxford University Press, 1938. 160 pages, illustrated, 9 by 6 inches, cloth, \$1.50. A concise yet comprehensive description of the modern railway, based upon British practice.

(A) TREATISE on LIGHT. By R. A. Houstoun. New York and London, Longmans, Green & Co., 1938. 528 pages, illustrated, 9 by 6 inches, cloth, \$4.50. Sections treat geometrical optics, physical optics, spectroscopy and photometry, and mathematical theory.

ATM (Archiv für technisches Messen), Lieferungen 88–90, October–December 1938. Munich & Berlin, R. Oldenbourg. Illustrated, 12 by 8 inches, paper, 1.50 rm. each. Three numbers of a monthly publication containing classified articles upon various types of apparatus and methods for technical measurements.

ALL ABOUT SUBWAYS. By G. Conklin. New York, Julian Messner, 1938. 212 pages, illustrated, 9 by 7 inches, cloth, \$2.50. Intended for young readers, this book tells in non-technical language the way subways are built.

CAPITAL CONSUMPTION and ADJUSTMENT. By S. Fabricant. New York, National Bureau of Economic Research, 1938. 271 pages, illustrated, 9 by 6 inches, cloth, \$2.75. This report is a study of the records of capital consumption and adjustment in the United States since 1918.

FUNDAMENTAL PRINCIPLES of PHYSICS. By H. G. Heil and W. H. Bennett. New York, Prentice-Hall, 1938. 631 pages, illustrated, 9 by 6 inches, cloth, \$5.00. Subjects usually found in an elementary text are here so arranged as to facilitate increasing use of the calculus in handling problems as the book progresses.

HIGH IRON, a Book of Trains. By L. Beebe. New York and London, D. Appleton-Century Co., 1938. 226 pages, illustrated, 11 by 8 inches, cloth, \$5.00. A collection of photographs, with descriptive text, having historical association.

(An) Introduction to the THEORY of NUMBERS. By G. H. Hardy and E. M. Wright. Oxford, England, Clarendon Press; New York, Oxford University Press, 1938. 403 pages, illustrated, 10 by 6 inches, cloth, \$8.00. Not a systematic treatise on the theory of numbers, this book comprises a series of introductions to the many sides of that theory.

KUNSTSTOFFE. Im Auftrage des Fachausschusses für Kunst- und Pressstoffe des Vereines deutscher Ingenieure. Edited by F. Pabst and R. Vieweg. Berlin, VDI-Verlag, 1938. 92 pages, illustrated, 8 by 6 inches, paper, 3 rm. This brief treatise on artificial materials covers cellulose derivatives, synthetic resins and other plastics, and synthetic rubber.

PUBLIC UTILITY REGULATION. By G. L. Wilson, J. M. Herring, and R. B. Eutsler. New York and London, McGraw-Hill Book Co., 1938. 571 pages, tables, 9 by 6 inches, cloth, \$4.00. An analysis of the nature, extent, and problems of public utility regulation is presented.

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Papers Presented at Pacific Coast Convention, Portland, Ore., August 9–12, 1938

No.	Authors	Titles of Papers (Some Shortened)
☐ 38-43	Lightning Arrester Subcom.	*Testing and Application of Lightning Arresters
☐ 38-99	Monroe	†Electrification of the San Francisco-Oakland Bay Bridge Railway
☐ 38-100	Whelchel	*Trends in Electrical Equipment in Hydraulic Power Plants
☐ 38-101	McMillan	*Polarity Limits of the Sphere Gap
☐ 38-102	Smith	*Use of Bismuth Bridge Magnetic Fluxmeter for A-C Fields
☐ 38-103	Shuck	*A Variable-Register-Ratio Watt-Hour Meter
☐ 38-104	Thomson	*Similitude of Critical Conditions in Ferroresonant Circuits
☐ 38-105	Morris	*Application of Copper-Oxide Rectifiers
☐ 38-106	Wagner	*Self-Excitation of Induction Motors
☐ 38-107	Ager	*Determination of Induction-Motor Performance
☐ 38-108	Dalziel	*Static Power Limits of Synchronous Machines
☐ 38-109	Peterson	*General Operation of Transmission Line
☐ 38-110	Cozzens & Peterson	*Corona Experience on Transmission Line
☐ 38-111	Cozzens	*Insulation and Lightning Protection
☐ 38-112	Laughlin	*Carrier-Current Equipment
☐ 38-114	Skellett	*Narrow-Band Transmission System for Animated Line Images
☐ 38-115	Norwine	*Controlling Amplitude Characteristics of Telephone Signals
☐ 38-116	Gaylord	*The Pumping System of the Colorado River Aqueduct
☐ 38-117	Skilling	*The Electrical Strength of Air at High Pressure
☐ 38-118	Pierce and Hamilton	*Phase-Angle Control of System Interconnections
☐ 38-119	Lyon	*The Electrostatic Unbalance of Transmission Lines

Papers Presented at Southern District Meeting, Miami, Fla., November 28–30, 1938

No.	Authors	Titles of Papers
☐ 38-124	Kirkwood	Grading the Engineer's Job
☐ 38-125	Almond	Electrical Design of Pickwick Landing Project
☐ 38-126	Jones	Mulsifyre System for Extinguishing Oil Fires
☐ 38-127	Housley	*Reconditioning of Insulating Oils by Activated Alumina
☐ 38-128	Stratton & Stratton	Shop Practice in the Repair of High-Voltage Bushings
☐ 38-129	George & Bessesen	*Generator Damper Windings at Wilson Dam

Papers Presented at Winter Convention, New York, N. Y., January 23–27, 1939

No.	Authors	Titles of Papers
☐ 38-122	Putman & Dann	Loading Transformers by Copper Temperature
☐ 39-4	Morgan, Brown & Schumer	Determination of Stray Load Loss in Induction Machines
☐ 39-5	Potter	Measurement of Temperature in Squirrel-Cage Induction Motors
☐ 39-6	Hellmund	The Rating of Electrical Machinery and Apparatus
☐ 39-8	Brown & Cahoon	An Amplifier-Wattmeter for Measurement of Watts and Vars
☐ 39-11	McDonald	Voltage Control of Mercury-Arc Rectifiers
☐ 39-13	Johnson	Predetermination of Temperatures in Resistance Welds
☐ 39-15	Relay Subcommittee	High-Speed Relaying Experience and Practise
☐ 39-17	Lynn	Effects of Temperature on Rotating Electrical Machinery
☐ 39-18	Rutherford	The Rating and Application of Motors for Refrigeration
☐ 39-19	AIEE & EEI Committees	Bus Protection
☐ 39-21	Konn & Craton	Performance of the 3600-Hp New Haven Electric Locomotives
☐ 39-22	Kotterman	The Magnesium Copper Sulphide Rectifier Battery Charger
☐ 39-23	Seletzky & Zucker	Sensitivity of the Four-Arm Bridge
☐ 39-24	DeBellis	Modernization of Switch House Design
☐ 39-26	Strang & Hanna	Modernization of Switch House Design
☐ 39-27	Harder	Relay Protection of Pennsylvania Railroad Electrification
☐ 39-28	Caruthers	Copper-Oxide Modulators in Carrier Telephone Systems
☐ 39-31	Smith, Sonnemann & Dodds	Applying Ratio Differential Relays for Bus Protection
☐ 39-32	Stitcher & Thomas	Effect of Corona Discharge on Liquid Dielectrics
☐ 39-33	Kent & Blye	Inductive Co-ordination With Series Sodium Lighting Circuits
☐ 39-34	Ludwig & Grissinger	A New High-Capacity Air Circuit Breaker
☐ 39-35	Dickinson	"De-Ion" Air Circuit Breaker for Central-Station Service
☐ 39-36	MacNeill & Hill	Multiple-Grid Breakers for High-Voltage Service
☐ 39-39	Cox & Jones	Ignitrons for the Transportation Industry
☐ 39-40	Gray & Breyer	An Electronic Control Circuit for Resistance Welders
☐ 39-41	Ingram	Cold-Cathode Gas-Filled Tubes as Circuit Elements
☐ 39-42	Cassidy & Mosteller	Continuous Processing for Automobile Tire Fabrics
☐ 39-43	Smith	Electric Drives for Supercalenders in Paper Mills
☐ 39-45	Chu & Barrow	Electromagnetic Horn Design
☐ 39-46	Byrne	Polyphase Broadcasting
☐ 39-47	Dellinger	The Role of the Ionosphere in Radio Wave Propagation
☐ 39-49	Peterson	Power System Voltage Recovery Characteristics
☐ 39-52	Clarke, Crary & Peterson	Overvoltages During Power System Faults
☐ 39-53	Kendall & Affel	A 12-Channel Carrier Telephone System for Open-Wire Lines
☐ 39-54	Lawton	The Submarine Cable Plow
☐ 39-55	Nelson	The Submarine Cable Depthometer
☐ 39-56	Sorber & Smith	Remote Control Tollboard
☐ 39-57	Scudder & Reynolds	Crossbar Dial Telephone Switching System
☐ 39-58	Corney & Edson	Modernization of L Street Station Switch House
☐ 39-59	Hildebrand	Duty Cycles and Motor Rating
☐ 39-65	Roby	Simplified Precision Resistance Welder Control
☐ 39-66	Wright	Power Supply for Single-Phase Resistance Welders
☐ 39-67	Holslag	The A-C Arc Progresses
☐ 39-68	Kidder	Notes on Emergency Ratings
☐ 39-69	Thomas	Economical Loading of Underground High-Voltage Cables
☐ 39-71	Shanklin	Low Gas Pressure Cable
☐ 39-72	Lincoln & Sprole	Demand Meter Time Periods
☐ 39-73	Keinath	An Automatic A-C Potentiometer and Applications to Testing
☐ 39-74	Green	Aluminum-Nickel-Cobalt Brake Magnets for Watt-Hour Meters

* These papers have been published in the Transactions section of Electrical Engineering.
† This paper has been published in the 1938 AIEE Transactions volume.